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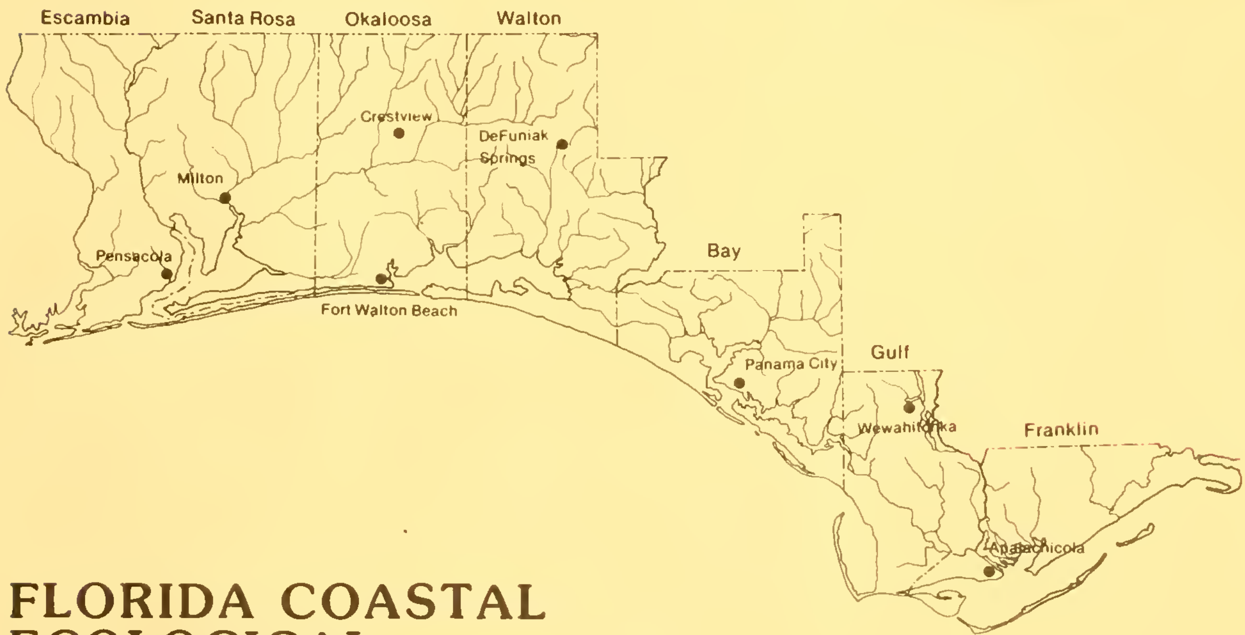

FLORIDA COASTAL ECOLOGICAL CHARACTERIZATION:

A Socioeconomic Study of the Northwestern Region

VOLUME I

TEXT

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FLORIDA COASTAL ECOLOGICAL CHARACTERIZATION: A SOCIOECONOMIC STUDY OF THE NORTHWESTERN REGION

Volume I

TEXT

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U.S. Department of the Interior
Washington, DC 20240

PREFACE

The purpose of this socioeconomic characterization study is to compile and synthesize information from existing sources about the social and economic characteristics of the northwestern coastal region of Florida, which is made up of Escambia, Santa Rosa, Okaloosa, Walton, Bay, Gulf, and Franklin Counties. This report and the data appendix should prove useful for coastal planning and management; it is one in a series of characterizations of coastal socioeconomic systems produced by the U.S. Fish and Wildlife Service. The series describes the components and interrelationships among complex processes that include population and demographic characteristics, mineral production, multiple-use conflicts, recreation and tourism, agricultural production, sport and commercial fishing, transportation, industrial and residential development, and environmental issues and regulations.

This study originally was under contract with the NANEX Systems Corporation, Crestview, Florida. The corporation is responsible for the compilations and accuracy of the Data Appendices and their lists of references. Most of the first drafts of the various chapters were prepared in 1980. Only a few of the sections of some of the reports have since been updated.

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INTRODUCTION

This report is a review of the population and demographic characteristics of Northwest Florida (Escambia, Santa Rosa, Okaloosa, Walton, Bay, Gulf and Franklin Counties). It explicates and synthesizes information on population, income, labor, health, education, and human services.

Because much of this report was written before the 1980 census data became available, projected population statistics for Northwest Florida in 1980 and after are based on trends from 1960 to 1970. The projections, based primarily on births, deaths, and migration, were prepared by the Population Division, Bureau of Economic and Business Research at the University of Florida.

STATE OF FLORIDA

From 1950 to 1960, Florida's population increased more (79%) than any other state. In 1960-70, the percentage increase was second only to Nevada and the increase in numbers was topped only by California.

From 1970 to 1980, Florida's population increased by 2.9 million (6.8 to 9.7 million, about 43%) according to the 1980 Census of Population and Housing, U.S. Department of Commerce (1981). Florida's population is now the eighth largest in the Nation.

Annual growth rates have varied considerably. The rate of growth was about 5% in the early 1950's, 8% in the late 1950's, 3% in the late 1960's, 5% in early 1970's, less than 2% in the mid 1970's, and 3% in 1979 (Florida Chamber of Commerce 1979). Florida's growth has brought about a steady increase in employment in the tourist trade, service, and manufacturing industries.

Florida's growth has been explosive. In 1950-80, its population increased from 2.7 million to 9.74 million (an increase of more than 250%), whereas the United States increase was only 45%. More than 90% of Florida's increase in population was caused by immigration from other states.

Florida currently has the largest population of persons 65 years and over of any of the 50 states. Most immigrants came to Florida for employment or to retire. In 1960-80, the number of retirees, age 65 or over, rose from 11.2% of the population of Florida in 1960 to 14.5% in 1970, and to 17.7% in 1980 (Florida Chamber of Commerce 1979). The average was about 10% nationally. Percentages in other age groups in 1978 were 21% (0-14 years), 39% (15-44 years), and 22% (45-64 years).

NORTHWEST FLORIDA

Population Change

The population of Northwest Florida was 537,061 in 1980 (Table 1). Since 1950, its population has grown more slowly than the State average. For example, Florida's population grew 78.7% in 1950-60, 37.2% in 1960-70, and 43.4% in 1970-80. The population growth of Northwest Florida was 58.5% in 1950-60, 20.1% in 1960-70, and 22.0% in 1970-80. Of the seven counties in 1950-80, the population of Escambia County was the largest, Okaloosa County grew the fastest, and Franklin County grew the slowest (Table 1).

Northwest Florida's population growth (natural increase and net migration) in 1950-80 is shown in Tables 2, 3, and 4. A natural increase is calculated as the number of deaths subtracted from the number of births over a given period of time. In 1950-80, most of the population growth in Northwest Florida was a natural increase rather than from immigration (Tables 3 and 4). For example, in Northwest Florida in 1970-80, net migration increased 48.8%, whereas migration for the State as a whole was 91.1% (Table 4).

Population Projections

Population growth in Northwest Florida is expected to be relatively light in 1982-2000 and then remain constant until 2020 (Figure 1 and Table 5).

Sex, Age, and White/Non-White Characteristics

The methodology used to compute estimates of the population and changes in this report assumes that the net effect of migration on the age, race, and sex components of a county's population in 1970-80 was similar to that of 1960-70. Lewis (1980) rationalizes this approach rather than using current symptomatic data.

Males outnumbered females in the 1950 census of the seven Northwest Florida counties (Table 6). White males outnumbered White females, and non-White females slightly outnumbered non-White males. The sex composition in 1960 and 1970 was similar (Tables 7 and 8). In 1978, females outnumbered both White and non-White males (Table 9).

In Northwest Florida, people younger than 18 years made up about 40% of the population in 1960, 36% in 1970, and 33% in 1978 (U.S. Department of Commerce, Bureau of Census 1963, 1973; Florida Statistical Abstract 1979). The elderly (65+ years) made up 5% of the population in 1960 and 8% in 1979, and those between ages 18 and 64 made up 55% and 59% of the population in 1960 and 1978. For all age groups, Whites made up 84% of the Northwest Florida population in 1960 and 85% in 1970.

Table 1. The population and percent increase in the counties of Northwest Florida at 10-year intervals from 1950 to 1980 (adapted from U.S. Department of Commerce 1953, 1963, 1973, 1981; Florida Statistical Abstract 1980).

County	1950	1960	1970	1980	Percent increase 1950-80	1950-60	1960-70	1970-80
Bay	42,689	67,131	75,283	97,740	129.0	57.3	12.1	29.8
Escambia	112,706	173,829	205,334	233,794	107.4	54.2	18.1	13.9
Franklin	5,814	6,576	7,065	7,661	31.8	13.1	7.4	8.4
Gulf	7,460	9,937	10,096	10,658	42.8	33.2	1.6	5.6
Okaloosa	27,533	61,175	88,187	109,920	299.2	122.2	44.2	24.6
Santa Rosa	18,554	29,547	37,741	55,988	201.8	59.2	27.7	48.3
Walton	14,725	15,576	16,087	21,300	45.0	5.8	3.3	3.2
Northwest Florida	229,481	363,771	439,793	537,061	134.0	58.5	20.1	22.0
Florida	2,771,305	4,951,560	6,791,418	9,739,992	251.5	78.7	37.2	43.4

Table 2. The population and changes in the counties of Northwest Florida from 1950 to 1960 (adapted from U.S. Department of Commerce 1953, 1962).

County	Population		Population increase		Natural change		Net gain	Net migration	Migration rate (%)[a]
	Census 1950	Census 1960	Number	Percent	Births	Deaths			
Bay	42,689	67,131	24,442	57.3	17,617	3,480	14,137	10,305	24.1
Escambia	112,706	173,829	61,123	54.2	48,840	10,493	38,347	22,776	20.2
Franklin	5,814	6,576	762	13.1	1,474	691	783	-21	-0.4
Gulf	7,460	9,937	2,477	33.2	2,609	606	2,003	474	6.4
Okaloosa	27,533	61,175	33,642	122.2	16,064	2,129	13,935	19,707	71.6
Santa Rosa	18,554	29,547	10,993	59.2	7,078	1,585	5,493	5,500	29.6
Walton	14,725	15,576	851	5.8	3,673	1,469	2,204	-1,353	-9.2
Region	229,481	363,771	134,290	58.5	97,355	20,453	76,902	57,388	25.0
Florida	2,771,305	4,951,560	2,180,255	78.7	914,762	351,260	563,502	1,616,753	58.3

[a] Net total migration as a percent of the 1950 population.

Table 3. The population and changes in the counties of Northwest Florida in 1960 and 1970 (adapted from U.S. Department of Commerce 1962, 1977).

County	Population		Population increase		Natural Change		Net gain	Net migration	Migration rate
	Census 1960	Census 1970	Number	Percent	Births	Deaths			
Bay	67,131	75,283	8,152	12.1	16,662	4,963	11,699	-3,547	-5.3
Escambia	173,829	205,334	31,505	18.1	46,813	13,589	33,224	-1,719	-1.0
Franklin	6,576	7,065	489	7.4	1,610	881	729	-240	-3.6
Gulf	9,937	10,096	159	1.6	2,178	752	1,426	-1,267	-12.8
Okaloosa	61,175	88,187	27,012	44.2	19,868	3,385	16,483	10,529	17.2
Santa Rosa	29,547	37,741	8,194	27.7	9,548	2,308	7,240	954	3.2
Walton	15,576	16,087	511	3.3	2,521	1,707	814	-303	-1.9
Region	363,771	439,793	76,022	20.9	99,200	27,585	71,615	4,407	1.2
Florida	4,951,560	6,789,443	1,837,883	37.1	1,107,116	595,541	511,575	1,326,308	26.8

[a]Net total migration as a percentage of the 1960 population.

Table 4. The population and changes in the counties of Northwest Florida from 1970 to 1980 (adapted from U.S. Department of Commerce 1973, 1981).

County	Population		Population change	Percent increase	Natural increase		Net migration	
	1970 Census	1980 Census	Net gain 1970-80		Number	Percent change[a]	Number	Percent change[a]
Bay	75,283	97,740	22,457	29.8	7,854	35.4	14,342	64.6
Escambia	205,334	233,794	28,460	13.9	20,658	74.1	7,204	25.9
Franklin	7,065	7,661	596	8.4	237	17.7	1,101	82.3
Gulf	10,096	10,658	562	5.6	713	67.7	340	32.3
Okaloosa	88,187	109,920	21,733	24.6	12,827	54.2	10,852	45.8
Santa Rosa	37,741	55,988	18,247	48.3	4,692	36.7	8,084	63.3
Walton	16,087	21,300	5,213	3.2	132	4.2	2,999	95.8
Region	439,793	537,061	97,268	22.1	47,113	51.2	44,922	48.8
Florida	6,791,418	9,739,992	2,948,574	43.4	217,567	8.9	2,236,246	91.1

[a]Calculated as a percent of net population increase.

Minority Group Composition

Blacks are the predominant minority group in Northwest Florida (Table 10). In 1980, Blacks, American Indians, Eskimos, Aleuts, Asians, and Pacific Islanders made up 16% of the population in Northwest Florida; the same as for the State.

The 1980 totals for the "White" and "other" categories are not comparable to the 1970 census. The explanation stems primarily from the way Hispanics reported their race in the 1980 census. Nationwide, a larger portion (40%) of people of Spanish origin did not report that they belonged to a specific race so they were included in the "other" category. Another 56% said they were White (U.S. Department of Commerce, Bureau of the Census 1981). Similar

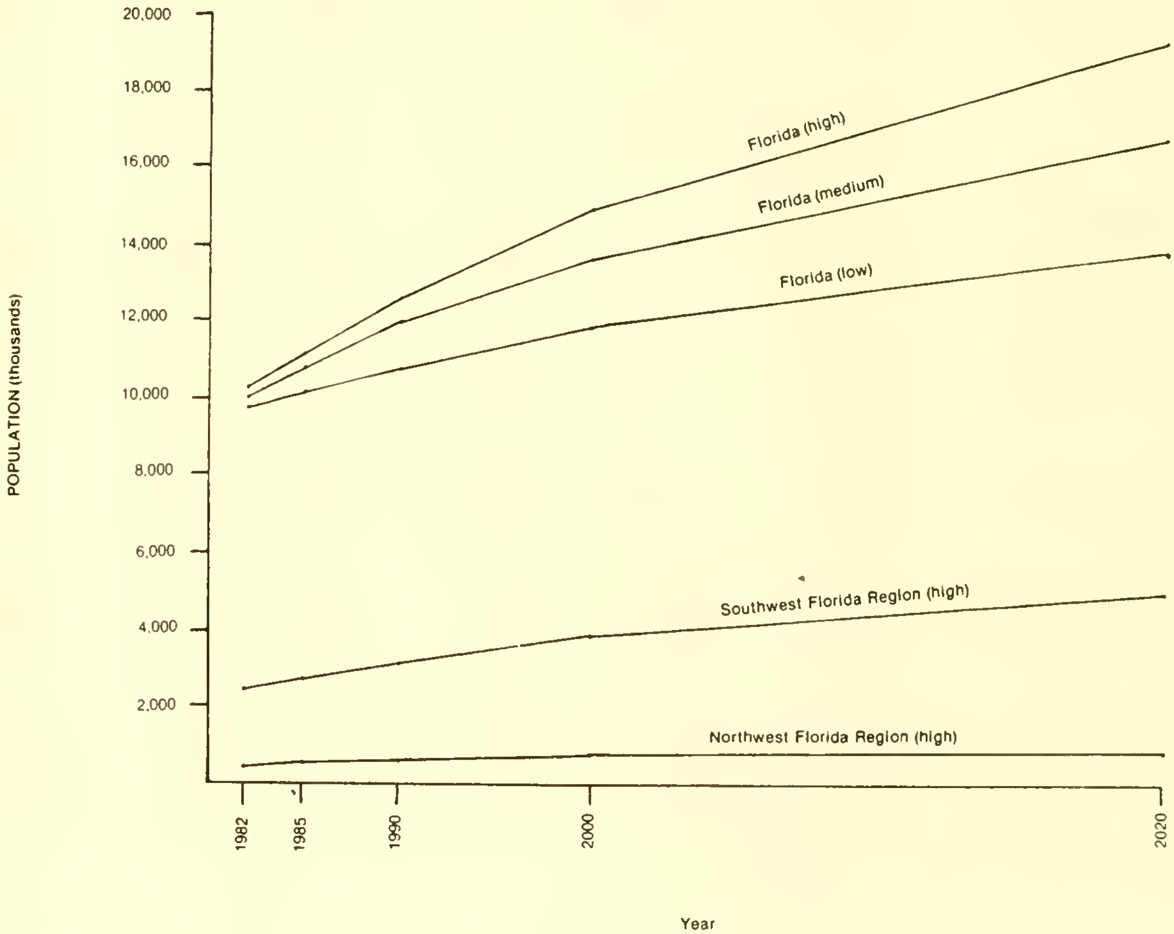

Figure 1. Florida population projections for 1980, 1990, 2000, and 2020 (Florida Statistical Abstract 1980).

Table 5. Population projections (thousands) for different levels of growth in 1982, 1985, 1990, 2000, and 2020 (Florida Statistical Abstract 1980).

County	Level of growth	Population projections 1982	1985	1990	2000	2020
Bay	low	101.2	104.8	109.9	119.3	140.3
	med	102.7	109.4	119.6	135.0	166.0
	high	104.2	112.3	125.0	147.8	190.7
Escambia	low	237.9	242.4	248.8	265.9	312.7
	med	239.7	248.1	260.9	287.8	353.8
	high	241.7	251.9	267.9	307.3	396.5
Franklin	low	8.7	9.0	9.3	10.0	11.7
	med	8.7	9.0	9.6	10.7	13.2
	high	8.9	9.5	10.3	12.0	15.5
Gulf	low	11.4	11.7	11.9	12.7	14.9
	med	11.4	11.7	12.2	13.4	16.4
	high	11.4	11.7	12.3	14.0	18.0
Okaloosa	low	116.8	120.7	126.4	137.2	161.4
	med	118.5	126.0	137.3	154.7	190.2
	high	120.2	129.2	143.3	169.0	218.0
Santa Rosa	low	53.1	55.2	58.2	63.5	74.6
	med	54.0	57.9	64.0	72.7	89.5
	high	54.9	59.7	67.3	80.2	103.4
Walton	low	20.2	20.8	21.6	23.3	27.4
	med	20.4	21.6	23.2	25.9	31.8
	high	20.6	21.8	23.8	27.8	35.9
Northwest Florida	low	549.3	564.6	586.1	631.9	743.0
	med	555.4	583.7	626.5	700.2	860.9
	high	561.9	596.1	649.9	758.1	978.0
Florida	low	9,755.3	10,167.2	10,751.2	11,751.3	13,817.8
	med	10,039.4	10,810.8	11,978.1	13,624.1	16,754.0
	high	10,213.6	11,133.1	12,591.5	15,033.3	19,397.9

Table 6. Number of Whites and non-Whites by sex in the counties of Northwest Florida in 1950; percentage of State total in parenthesis (adapted from U.S. Department of Commerce 1953).

County	Total	White and non-White		White		Non-White	
		Male[a]	Female[a]	Male	Female	Male	Female
Bay	42,689	21,879	20,810	18,422	17,102	3,457	3,708
Escambia	112,706	56,455	56,251	44,753	42,830	11,702	13,421
Franklin	5,814	2,800	3,014	2,131	2,187	669	827
Gulf	7,460	3,731	3,731	2,776	2,677	953	1,054
Okaloosa	27,533	15,404	12,129	14,111	11,224	1,293	905
Santa Rosa	18,554	9,742	8,812	8,955	8,015	787	797
Walton	14,725	7,294	7,431	6,343	6,424	951	1,007
Southwest Florida	229,481 (8.2%)	117,303 (4.2%)	112,178 (4.0%)	97,491 (3.5%)	90,459 (3.3%)	19,812 (0.7%)	21,719 (0.7%)
Florida	2,771,305	1,367,917	1,404,388	1,073,495	1,093,556	294,422	310,832

[a]County tabulations subject to error.

Table 7. Number of Whites and non-Whites by sex in the counties of Northwest Florida in 1960. Percentage of State total in parenthesis (adapted from U.S. Department of Commerce 1963).

County	Total	Whites and non-Whites		White		Non-White	
		Male	Female	Male	Female	Male	Female
Bay	67,131	34,265	32,866	29,554	27,526	4,711	5,340
Escambia	173,829	86,213	87,616	68,832	68,593	17,381	19,023
Franklin	6,576	3,193	3,383	2,540	2,640	653	743
Gulf	9,937	4,988	4,949	3,827	3,723	1,161	1,226
Okaloosa	61,175	31,771	29,404	29,656	27,323	2,115	2,081
Santa Rosa	29,547	15,572	13,975	14,476	12,908	1,096	1,067
Walton	15,576	7,753	7,823	6,719	6,742	1,034	1,081
Region	363,771 (7.3%)	183,755 (3.7%)	180,016 (3.6%)	155,604 (3.1%)	149,455 (3.0%)	28,151 (0.6%)	30,561 (0.6%)
Florida	4,951,560	2,436,783	2,514,777	2,000,593	2,063,288	436,190	451,489

Table 8. Number of Whites and non-Whites by sex in the counties of Northwest Florida in 1970; percentage of State total given in parenthesis (adapted from U.S. Department of Commerce 1973).

County	Total	Whites and non-Whites		White		Non-White	
		Male	Female	Male[a]	Female	Male	Female
Bay	75,283	36,916	38,367	32,206	32,997	4,710	5,370
Escambia	205,334	102,350	102,984	82,236	80,778	20,114	22,206
Franklin	7,065	3,429	3,636	2,806	2,924	623	712
Gulf	10,096	5,074	5,022	3,930	3,820	1,144	1,202
Okaloosa	88,187	45,701	42,486	42,085	39,134	3,616	3,352
Santa Rosa	37,741	19,384	18,357	18,280	17,212	1,104	1,145
Walton	16,087	7,818	8,269	6,975	7,290	843	979
Region	439,793 (6.5%)	220,672 (3.3%)	219,121 (3.2%)	118,518 (2.8%)	184,155 (2.7%)	32,154 (0.5%)	34,966 (0.5%)
Florida	6,789,443	3,275,571	3,513,872	2,762,779	2,956,564	512,792	557,308

[a]County tabulations subject to error.

Table 9. Number of Whites and non-Whites by sex in the counties of Northwest Florida in 1978. Percentage of State total in parenthesis (adapted from Florida Statistical Abstract 1979).

County	Total	White and non-White		White		Non-White	
		Male	Female	Male	Female	Male	Female
Bay	96,525	47,077	49,448	42,104	43,549	4,973	5,899
Escambia	231,133	113,982	117,151	92,366	92,626	21,616	24,525
Franklin	8,388	4,015	4,373	3,408	3,625	607	748
Gulf	11,081	5,438	5,643	4,288	4,411	1,150	1,232
Okaloosa	110,106	55,944	54,162	51,296	49,322	4,648	4,840
Santa Rosa	50,284	24,854	25,430	23,790	24,189	1,064	1,241
Walton	19,059	9,045	10,014	8,268	9,067	777	947
Region	526,576 (5.9%)	260,355 (2.9%)	266,221 (3.0%)	225,520 (2.5%)	226,789 (2.5%)	34,835 (0.4%)	39,432 (0.5%)
Florida	8,966,395	4,281,389	4,685,006	3,714,345	4,046,381	567,044	638,625

Table 10. The population and percentage of ethnic/racial/minority groups in the counties of Northwest Florida in 1980 (adapted from U.S. Department of Commerce, Bureau of the Census 1981).

County	Total population[a]	White	Minorities			Ethnic[b]	
			Black	American Indians, Eskimos, Aleuts	Asian/Pacific Islanders	Other	Spanish origin
Bay	97,740	83,799	11,681	423	1,065	772	1,537
Escambia	233,744	181,637	45,945	1,876	3,036	1,300	3,887
Franklin	7,661	6,530	1,098	17	8	8	70
Gulf	10,658	8,456	2,139	28	23	12	147
Okaloosa	109,920	97,093	9,483	420	1,511	1,413	2,577
Santa Rosa	55,988	52,468	2,501	276	520	223	752
Walton	21,300	18,910	2,051	218	71	50	173
Northwest Florida	537,061	448,893 (83.6%)	74,898 (13.9%)	3,258 (0.6%)	6,234 (1.2%)	3,778 (0.7%)	9,143 (1.7%)
Florida	9,739,992	8,178,387 (84%)	1,342,478 (14%)	14,316 (0.2%)	56,756 (0.4%)	143,055 (1.4%)	857,898 (8.8%)

[a] County tabulations subject to error.
[b] Persons of Spanish origin may be of any race and are enumerated in the totals for the minority categories. However, most persons of Spanish origin classify themselves as White (estimates are as high as 90%). In summary, persons of Spanish origin constituted 8.8% of the State's population distribution in 1980 compared to approximately 1.7% for the northwest region.

changes are reflected in the reporting by people of Spanish origin in the categories of "White" and "other" in Florida and Northwest Florida. In all, people of Spanish origin made up about 2% of the population in Northwest Florida, and 8.8% for the State as a whole. These population counts probably miss a large portion of the illegal alien residents in Florida.

The percentage of young persons (16-24 years of age) in the population of the United States will continue to increase primarily because of the rapidly expanding minority population (Table 11). The percentage of non-Whites in this age group in the United States is expected to rise from 13.5% in 1970 to 20.1% in 1995. Similar or even stronger trends are predicted for Florida, and possibly for Northwest Florida, despite a relatively high emigration of minorities from there in the 1970's.

INCOME CHARACTERISTICS

INCOME LEVELS

Because of the income sharing arrangements commonly found among families living together or as units, family income data probably reveal a better picture of the economic status of residents in Northwest Florida than per capita income.

The median family income for Northwest Florida was $2,054 in 1950 and $4,392 in 1960, an increase of 113.8% (Table 12). From 1960 to 1969 median family income increased to $7,130 (62%) and in 1979 it increased to $13,792, a 93.4% increase.

The median family income in Northwest Florida was less than that for the State. For example, in 1950-79 family income increased from $2,054 to $13,792 (571.5%) in Northwest Florida, and from $2,400 to $17,558 (an increase of 631.6%) statewide.

Of the counties in Northwest Florida in 1979, Franklin County had the lowest median family income, about $5,000 below most of the other counties and much less than the median for the State ($17,558). Franklin County also had the lowest percentage increase in median family income in 1950-79 (434%); Santa Rosa had the largest increase (795%).

Per capita income also is a useful measure of an area's economic status. From 1950 to 1980, growth of personal income in Northwest Florida lagged behind that of the State. It was $382 below that for the State in 1950; $556 below in 1960; $738 below in 1970; and $1,800 below in 1978 (Table 13).

INCIDENCE OF POVERTY

The percentage of people with low incomes was higher in Northwest Florida than in other areas of the State (Table 14). In 1970, 20% of the families had incomes at the poverty level ($3,968 or less for a family of four) and only 10.4% (about 17% for the State) of the families had incomes exceeding $15,000. Less than 9% of the families in Franklin, Gulf, and Walton Counties earned

Table 11. The percentage composition of 16- to 24-year old Whites, Blacks, and their races combined, in the United States in 1970 and 1977, and projected to 1995 (adapted from Lewis and Russell 1980).

Year	Race			
	White	Black	Other	All non-Whites
1970	86.5	12.3	1.2	13.5
1977	84.7	13.6	1.7	15.3
1995	79.9	16.2	3.9	20.1

more that $15,000 in 1970. About one-third of the families in Franklin County lived at the poverty level. Family income was highest in Okaloosa County; only 12% were below the poverty level and about 15% had incomes of $15,000 or more.

The number of persons receiving Aid to Families with Dependent Children (AFDC) and food stamps is another index of poverty in Northwest Florida. Approximately 18% of families receiving AFDC funds and food stamps in the State were located in Northwest Florida in 1978 (Florida Department of Public Welfare 1978).

EDUCATION

The median school years completed by residents in Northwest Florida in 1950-70 was 10.0, somewhat lower than the State median of 10.7. These computations were made from data supplied in Tables POP 11-22 in the Data Appendix of this report. Other data on the characteristics of the school system, enrollment, and educational attainment also are located in the Data Appendix.

The differences between the State and Northwest Florida median educational level were not tested for statistical significance, but it appears that residents in Northwest Florida tend to be somewhat less educated than those for the State as a whole. Of all the residents within Northwest Florida, residents of Franklin County were least educated.

Educational data for number of public K-12 schools, students, full-time staff, high school graduates, value of property, expenditures, number of non-public schools, and non-public school students are given in Table 15. School facilities, teachers, and school property value can be described, at best, as adequate in meeting the educational needs of the citizenry in Northwest Florida.

Table 12. Median family income (dollars) in the counties of Northwest Florida in 1950, 1960, 1969, and 1979 (U.S. Department of Commerce 1953, 1963, 1970, and 1980).

County	1950	1960	Percent increase	1969	Percent increase	1979	Percent increase	1950-79
Bay	1,498	4,413		7,416		13,600		444.4
Escambia	2,650	5,174		8,027		14,600		450.9
Franklin	1,536	2,699		4,338		8,200		433.9
Gulf	2,054	4,858		7,322		13,500		557.3
Okaloosa	2,215	4,901		7,876		14,600		559.1
Santa Rosa	1,631	4,692		7,707		14,600		795.2
Walton	1,273	3,138		5,828		10,600		732.7
Northwest Florida	2,054	4,392	(113.8)	7,130	(62.3)	13,792	(93.4)	571.5
Florida	2,400	4,720	(96.7)	8,274	(75.3)	17,558	(112.3)	631.6

Table 13. Per capita personal income (dollars)[a] for counties in Northwest Florida in 1950, 1960, 1970, and 1978 (Florida Statistical Abstract 1962, 1977, 1980).

County	1950	1960	Percent increase	1970	Percent increase	1978	Percent increase
Bay	1,047	1,527		2,833		5,994	
Escambia	1,218	1,909		3,147		6,050	
Franklin	710	1,000		1,679		3,679	
Gulf	1,134	1,908		2,693		6,137	
Okaloosa	1,118	1,857		3,032		6,031	
Santa Rosa	730	985		3,145		5,671	
Walton	573	840		2,192		4,782	
Northwest Florida	932	1,432	(53.6)	3,000	(109.5)	5,778	(92.6)
Florida	1,314	1,988	(51.3)	3,738	(88.0)	7,578	(102.7)

[a]Per capita income for the region was computed by multiplying the per capita income in each county by the population of that county, aggregating these products for all seven counties, and dividing the aggregate by the region's total population.

Table 14. Percentage of families with incomes less than $3,968 and percentages exceeding $15,000 in the counties of Northwest Florida in 1970 (U.S. Department of Commerce, Bureau of the Census 1972).

County	Poverty level (less than $3,968)	$3,968 to $14,999	$15,000 or more
Bay	18.0	69.5	12.5
Escambia	15.3	72.5	12.2
Franklin	31.1	62.0	6.9
Gulf	20.0	73.1	6.9
Okaloosa	12.1	73.4	14.5
Santa Rosa	16.4	71.7	11.9
Walton	26.4	65.5	8.1
Northwest Florida	19.9	69.7	10.4
Florida	12.7	70.5	16.8

Education at higher levels is upgrading the citizenry. Adult basic education programs and post-secondary facilities, such as the University of West Florida and Pensacola Junior College, have the potential to increase local occupational skills and have a stabilizing influence on the economy in the region (Table 16).

LABOR FORCE CHARACTERISTICS

The two major factors that will influence the labor market between 1980 and 2020 are the potential rate of recruitment into the labor force, and the age composition of the labor force. Since the baby-boom group (those born between 1945-63) already is absorbed into the labor market, natural recruitment into the labor force should decline.

The characteristics of the labor force in Northwest Florida in 1970 were considerably different from those for the State. The percentage of males 18-24 years of age in the labor force and those over 65 is greater in Northwest Florida, but the percentage of females 16 years and older and married women was slightly less (Table 17).

The percentage of employed persons in manufacturing and government jobs was greater in Northwest Florida than for the State; but the percentage employed in clerical or white collar jobs was less than the State as a whole (Table 18).

Table 15. Education data for number of public K-12 schools, students, full-time staff, high school graduates, value of property, expenditures, number of non-public schools and non-public school students in FY 1978-79 (Florida Department of Education 1980a).

County	Number of public K-12 schools[a]	Number of students K-12	Number of full-time staff	Number of high school graduates
Bay	30	18,180	2,190	1,340
Escambia	82	38,822	4,426	2,607
Franklin	5	1,670	194	97
Gulf	6	2,211	289	165
Okaloosa	36	22,579	2,729	1,874
Santa Rosa	23	11,058	1,354	931
Walton	9	3,406	429	255
Northwest Florida	191	97,926	11,611	7,269
Florida	2,256	1,367,298	147,939	88,519

County	Assessed value of property	Total expenditures all funds	Number of non-public schools	Number of non-public students
Bay	1,064,278,818	36,979,365	7	1,131
Escambia	1,892,604,427	77,354,266	26	5,644
Franklin	109,340,822	5,685,463	1	40
Gulf	113,886,220	4,900,979	2	61
Okaloosa	896,201,061	45,108,363	5	416
Santa Rosa	929,540,786	22,753,939	2	422
Walton	254,448,391	6,374,706	1	56
Northwest Florida	5,260,300,525	199,157,081	44	7,770
Florida	117,592,872,456	2,962,686,564	871	176,601

[a] Includes adult schools.
[b] Fall, 1978.
[c] Grades 1-12.

Table 16. Adult basic education enrollment by race and age 65 and over for FY 1978-79 (Florida Department of Education, Division of Community Colleges 1980b).

County	White Non-Hispanic		Black Non-Hispanic		Hispanic	
	male	female	male	female	male	female
Bay	393	535	59	132	1	11
Escambia	87	325	116	406	1	5
Franklin	11	36	--	24	--	--
Gulf	57	95	30	59	--	1
Okaloosa	40	99	26	24	--	--
Santa Rosa	315	382	73	54	4	8
Walton	--	--	--	--	--	--
Northwest Florida	903	1,472	304	699	6	14
Florida	96,818	147,131	34,506	43,621	25,806	38,817

The percentage of unemployed in the civilian labor force was 4.2% in Northwest Florida and 3.8% for Florida (Table 17). The percentage of unemployed remained considerably above the State level of unemployment through the 1970's and into the 1980's. In April 1982, the unemployment rate was 9.6% for Northwest Florida and 7.1% for the State. Unemployment in 1982 was highest (12.8%) in Gulf county and lowest (6.9%) in Santa Rosa County. The unemployment picture is not expected to improve in the immediate future. Two major reasons for this prediction are limited employment opportunities (especially opportunities for work in business and industry) and severe seasonal fluctuations in employment in Northwest Florida. The number of people employed in the counties of Northwest Florida in 1971-78 is given in Table 19.

The number of women in the labor market increased in the 1970's and will probably continue to increase in the 1980's. In recent years, many women have taken jobs to supplement the family income, to offset inflation, or support themselves and their children.

PUBLIC HEALTH

Northwest Florida has less than 1% of the dentists, 4% of the medical doctors, 5% of the pharmacists, 3% of the chiropractors, 7% of licensed practical nurses, 5% of registered nurses, 1% of the osteopaths, 1% of the podiatrists, and 4% of the veterinarians in the State. Unemployment is especially acute for some counties because over three-fourths of the licensed health

Table 17. Percentage of different sexes and age groups in the labor force and rate of unemployment in Northwest Florida in 1970 (U.S. Department of Commerce, Bureau of the Census 1972).

County	Sex and age				Civilian labor force
	Females 16 years and older	Married women husband present	Males		
			18 to 24 years	65 & over	Percent unemployed
Bay	40.0	37.5	82.4	22.5	4.3
Escambia	38.1	35.3	86.0	18.8	5.2
Franklin	39.2	46.8	75.4	19.4	3.7
Gulf	32.7	31.9	80.1	21.2	2.2
Okaloosa	38.1	34.8	90.4	18.7	6.5
Santa Rosa	35.6	34.4	89.6	24.6	3.9
Walton	29.5	31.9	64.6	15.6	3.3
Northwest Florida	36.2	36.1	81.2	20.1	4.2
Florida	39.1	36.9	75.4	17.5	3.8

Table 18. Percentage of the available work force working in different occupations in Northwest Florida in 1970 (U.S. Department of Commerce, Bureau of the Census 1972).

County	Occupation			
	Manufacturing	Clerical or white collar	Government positions	Other
Bay	12.4	48.0	22.8	16.2
Escambia	17.1	48.1	24.2	10.6
Franklin	19.5	30.6	17.6	32.3
Gulf	36.7	36.8	18.4	8.1
Okaloosa	9.2	56.0	33.3	1.5
Santa Rosa	23.8	46.7	26.0	3.5
Walton	15.9	37.8	28.7	17.6
Northwest Florida	19.2	43.4	24.4	13.0
Florida	14.1	49.8	16.0	20.1

Table 19. The number of employees in the counties of Northwest Florida in 1971-78 (Florida Department of Commerce, Division of Economic Development 1979a-1979g; Florida Statistical Abstract 1980.

County	1971	1972	1973	1974	1975	1976	1977	1978
Bay	25,612	24,601	25,700	29,044	28,565	30,109	31,868	34,208
Escambia	78,556	81,499	85,539	75,367	76,722	78,007	77,976	83,808
Franklin	2,140	2,088	2,168	1,802	1,682	1,783	1,636	1,705
Gulf	4,106	2,383	3,129	2,952	2,555	3,410	2,529	3,090
Okaloosa	21,296	23,340	23,934	29,048	27,983	29,562	29,422	31,061
Santa Rosa[a]	--	--	--	15,459	15,926	17,170	17,163	18,447
Walton	5,276	5,494	5,043	5,921	5,301	5,659	6,069	6,602
Region	136,986	139,405	145,513	159,593	158,734	165,700	166,663	178,921
Florida	2,628,000	2,715,000	2,957,000	3,099,000	3,053,000	3,131,000	3,232,000	3,464,000

[a]Data included in Escambia county in 1971-73.

professionals in Northwest Florida are in Bay, Escambia, and Okaloosa Counties (Table 20).

About 5% of the hospitals and beds in the State are in Northwest Florida. In 1979-80, it had 4.0 beds per 1,000 population compared to 5.5 for the State (Table 21). The number of licensed professionals and medical facilities is likely to remain constant in the 1980's. Although the number of employees in health services has increased steadily since 1956, the percentage increase is less than that for the State (Table 22).

WHOLESALE AND RETAIL TRADE

Florida had the largest population increase and more retail sales from 1950 to 1980 than any other State in the southeast United States. In 1979, Florida's retail sales of $40.5 billion were seventh among all states.

The number of wholesale and retail establishments and sales volume in Northwest Florida in 1960-80 lagged considerably behind the State (U.S. Department of Commerce 1962, 1967, 1973; Florida Statistical Abstract 1980). This deficiency is not surprising given the slow growth in the economy and the high degree of unemployment in Northwest Florida. Tables EMP28 to EMP 38 in the Data Appendix describe the retail and wholesale establishments in Northwest Florida. The wholesale and retail trade sector provides goods and services for local consumption. With the exception of goods and services sold to tourists, the wholesale and trade sector generates little income for the gulf coast economy. Wholesale and retail trade is dependent upon income-producing sectors for its existence.

SUMMARY AND CONCLUSIONS

In general terms, Northwest Florida is rather sparsely populated, decidedly more rural than urban and relatively slow growing compared to the State as a whole. Recent population increases are due to natural increases rather than to immigration.

Blacks are the largest and Hispanics are the second largest non-White groups in Northwest Florida. Females, both Black and White, outnumber males. Whites outnumber non-Whites by a substantial margin. Future population projections are that there will be minimal growth in the next 40 years.

The Northwest Florida region is weaker economically than most other areas of Florida. In 1970, about 20% of families were at the poverty level and only about 10% earned $15,000 or more. Most poor people receive food stamps and aid for families with dependent children (AFDC) funds.

Median school years completed in Northwest Florida are lower than for the State and non-Whites tend to have less education than Whites.

Unemployment in Northwest Florida is higher than the State average. Although males are far more abundant in the labor market than females, female employment had increased considerably since 1950.

Table 20. The numbers of licensed health professionals in Northwest Florida in January 1981 and their percentage contribution in parentheses to the State total (Florida Department of Professional Regulation 1981).

County	Chiropractors	Dentists	Licensed practical nurses	Registered nurses	Optometrists	Medical doctors
Bay	11	37	318	526	12	110
Escambia	13	102	1,364	1,669	13	420
Franklin	0	1	17	20	0	3
Gulf	0	2	28	31	1	7
Okaloosa	9	47	252	565	12	119
Santa Rosa	2	16	269	398	2	46
Walton	3	3	26	51	1	9
Northwest Florida	38 (2.6%)	208 (4.2%)	2,274 (7.2%)	3,260 (5.1%)	41 (4.6%)	714 (4.0%)
Florida	1,428	4,901	31,699	64,365	885	17,815

County	Osteopaths	Pharmacists	Podiatrists	Veterinarians
Bay	7	69	2	10
Escambia	5	159	3	28
Franklin	1	6	0	1
Gulf	0	4	0	0
Okaloosa	1	50	1	13
Santa Rosa	0	40	0	4
Walton	0	11	0	2
Northwest Florida	14 (1.4%)	339 (5.0%)	6 (1.3%)	58 (3.9%)
Florida	999	6,766	461	1,504

Table 21. The number of licensed general hospitals[a], number of beds, and the number of beds per 1000 population for FY 1977-78, FY 1978-79 and FY 1979-80 in Northwest Florida and their contribution in parenthesis to the State total (Florida statistical abstract 1978, 1979, 1980).

	FY 1977-78			FT 1978-79		
County	Hospitals	Beds	Number of beds per 1,000 population	Hospitals	Beds	Number of beds per 1,000 population
Bay	2	384	4.02	2	384	3.94
Escambia	5	1,364	5.94	5	1,370	5.93
Franklin	1	26	3.20	1	26	3.10
Gulf	1	45	4.07	1	45	4.06
Okaloosa	4	452	4.23	4	452	4.11
Santa Rosa	2	205	4.10	2	205	4.08
Walton	1	50	2.63	1	50	2.62
Northwest Florida	16 (7.5%)	2,526 (5.2%)	4.02	16 (5.4%)	2,532 (5.1%)	3.97
Florida	214	48,156	5.52	296	49,294	5.50

	FY 1979-80		
County	Hospitals	Beds	Number of beds per 1,000 population
Bay	2	384	3.94
Escambia	5	1,370	5.87
Franklin	1	29	3.45
Gulf	1	45	4.04
Okaloosa	4	471	4.21
Santa Rosa	2	205	4.06
Walton	1	50	2.60
Northwest Florida	16 (7.4%)	2,554 (5.1%)	4.02
Florida	215	50,347	5.45

[a]Includes general hospitals without obstetrics.

Table 22. Number of employees in the health services of Northwest Florida and their percent increase in parentheses for 1956, 1959, 1965, 1970, 1975, and 1978 (U.S. Department of Commerce 1958, 1961, 1966, 1971, 1980).[a]

County	1956	1959	1965	1970	1975	1978
Bay	157	191	227	417	775	1,289
Escambia	330	1,238	1,600	2,533	4,105	5,491
Okaloosa	63	56	80	154	871	1,073
Santa Rosa	N.D.	N.D.	44	74	135	254
Walton	N.D.	N.D.	66	77	--	56
Northwest Florida	550	1,485 (170%)	2,017 (61.4%)	3,255 (61.4%)	5,886 (80.8%)	8,163 (38.7%)
Florida	12,418	29,128 (134.6%)	48,698 (67.2%)	83,939 (72.4%)	142,801 (70.1%)	174,054 (21.9%)

[a]No data are available for Franklin and Gulf Counties or for some years for Santa Rosa and Walton Counties.

Northwest Florida lacks licensed professionals and adequate medical facilities considering its area and population. For example, it has less than 1% of the dentists, 4% of the medical doctors, and only 5% of the registered nurses of the State of Florida's total licensed medical professionals.

DATA GAPS AND INCONSISTENCIES

This report is out-of-date in several areas (e.g., current number of employed persons, percentage of families at or below the poverty level, net migration of minorities in Northwest Florida) because it was prepared just before the 1980 population census by the Bureau of the Census. Another report such as this should be undertaken based on the 1980 census data.

No data were available from the Bureau of Census in 1950 to 1959 on the number of non-Whites if there were fewer than 5,000 non-Whites in a particular county.

RECOMMENDATIONS

Based upon the many perspectives gained from writing this report on the population and demographic characteristics of Northwest Florida, the following recommendations are offered:

1. Since parts of this report are not based on 1980 census data, another report such as this should be undertaken using the 1980 census data.

2. State and regional planning agencies should fill data gaps and avoid deficiencies in census data. To accomplish this, a more credible and comprehensive data collection and monitoring network must be established within the State. In general, the social and demographic data necessary for a study of this type are available. These data should be collected, compiled, and reported periodically so that policy-makers and planners can better develop goals, policies and strategies.

3. Improved methodology should be employed to validate ways of measuring rates of changes within specific time frames (e.g. change from 1960-69 to 1970-79) in relation to changes in the age, race, and sex computations of the people in Florida. If possible, methods of establishing quantitative errors for these estimates and changes need to be determined.

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TRANSPORTATION

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INTRODUCTION

This report is a review of the transportation systems in Bay, Escambia, Franklin, Gulf, Okaloosa, Santa Rosa, and Walton Counties of Northwest Florida. The systems reviewed are seaports, airports, railroads, highways, bus, air, and pipelines.

Reasonably detailed information was available on all but railroad and pipeline systems. A synthesis of the data findings on modes of transportation is given in the following sections. Short tons (2,000 lb) are used in this report and sometimes are referred to as volume.

SEAPORTS

PORT LOCATIONS

The location of the three major seaports in Northwest Florida (Pensacola, Panama City, and Port St. Joe) are shown in Figure 1. The harbors and shipping channels of the three ports exceed the depth requirements (8 m or 27 ft) for most merchant ships and ocean barges (Florida Department of Transportation 1978a).

The smaller ports at Apalachicola and Carabelle (Figure 1) have neither the channel depth nor the facilities to engage in commercial cargo, but they serve as bases for fishing fleets and pleasure boats.

PORT CHARACTERISTICS

This section concerns the physical characteristics and the past and projected cargo volume (tonnage) of the three major ports in Northwest Florida. Data on historical volumes of cargo are taken from the U.S. Army Corps of Engineers, Waterborne Commerce of the United States (1960, 1965, 1970, 1975, and 1978). Physical characteristics of the ports, capacities, and projections are taken from the Florida Waterport Systems Study (Florida Department of Transportation 1978a).

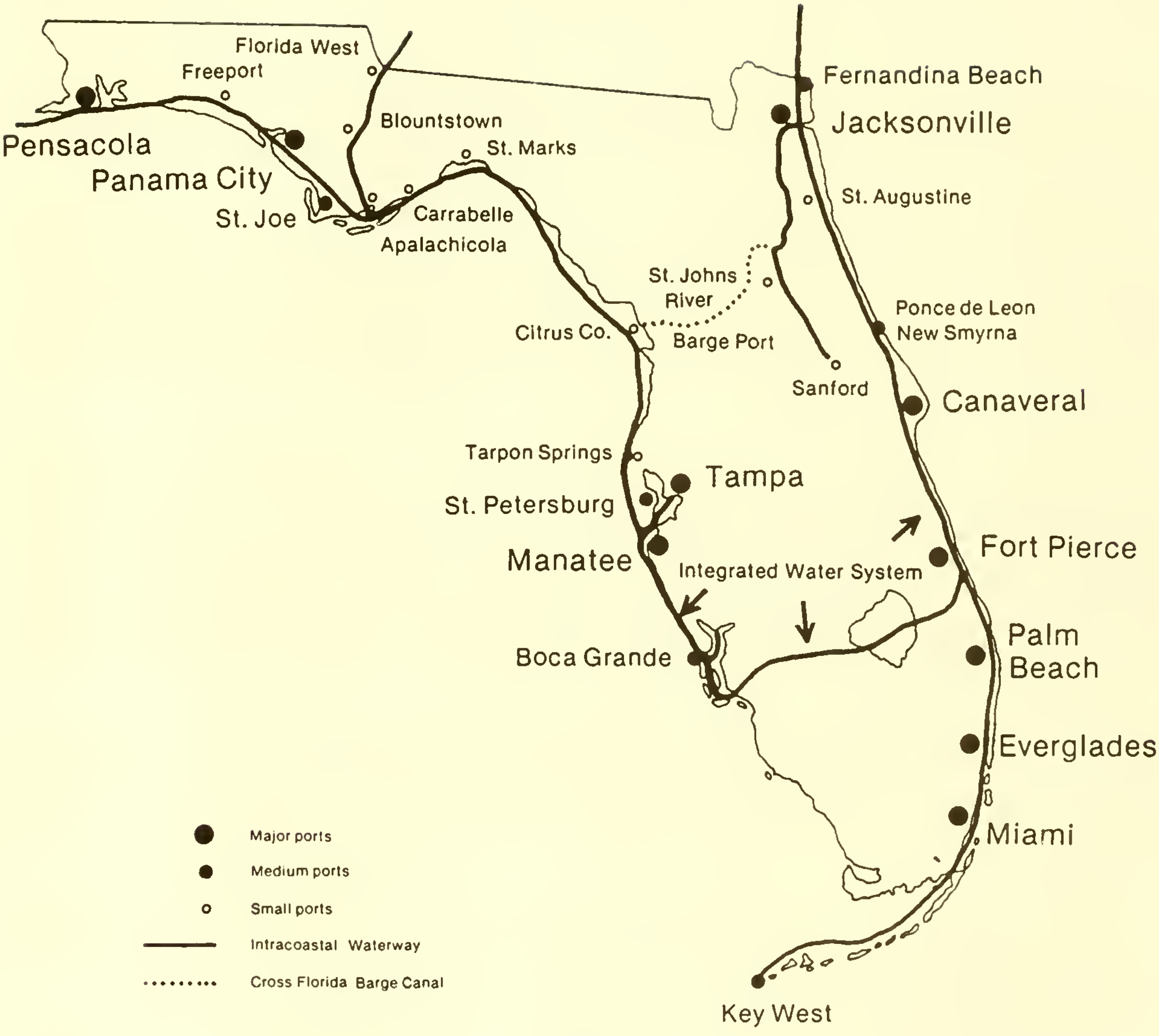

Figure 1. Ports and waterways in Florida (Florida Department of Transportation 1978b).

Pensacola

The Port of Pensacola is located on a 33.2-ha (82-acre) site situated on the north shore of Pensacola Bay in Escambia County. The channel to the gulf is 35 ft deep and 800 ft wide. Other means of access to the port are the Intracoastal Waterway, the St. Louis-San Francisco Railway, the Louisville and Nashville Railroad, an Interstate Highway (I-10), and the Pensacola Regional Airport.

The covered cargo storage capacity in 1976 was about 357,100 ft^3. Ship berthing facilities included 2,930 ft of public deepwater wharves maintained at a 33-ft depth, and 3,000 ft of public shallow-water wharves. Privately operated wharves added an additional 4,495 ft of berthing space.

Estimates of the throughput cargo handling capacity (normal daily cargo volume based on a 40 hr work week) for the Ports of Pensacola and Panama City were made by the Florida Waterport Systems Study (Florida Department of Transportation 1978a). These estimates utilized port labor and equipment productivity relationships provided by the U.S. Department of Commerce, Federal Maritime Administration, and assumed a normal work week of 5 days and a rate of berth occupancy of 50%.

Estimates are made in break bulk, dry bulk, liquid bulk, and general cargo categories of shipment. Break bulk refers to cargo in a vessel that can be counted by unit (e.g., tractors). Dry bulk and liquid bulk refer to bulk cargo carried in specially designed ships, and general cargo refers to any commodity shipped in boxes, crates, or other packaging (Olsen 1981). Estimated throughput capacities for Port Pensacola are shown in Table 1. The limiting capacity for break bulk cargo at Pensacola was due to the rail storage transfer limitation of 463,000 tons per year.

Table 1. Average annual throughput capacity in tons for the Port of Pensacola in 1960-78 (Florida Department of Transportation 1978a).

Cargo	Capacity
Break bulk cargo	
ship/apron transfer	902,000
rail/storage transfer	463,000
covered storage	609,000
Liquid bulk	
petroleum, sulphur	1,000,000
Dry bulk	
various	150,000

Examination of the Port of Pensacola's overall freight tonnage in 1960-1978 indicates that it is a growing port with substantial increases in shipping volume (Table 2). In 1975, Pensacola's volume of waterborne commerce was 2,262,000 short tons, about 2.8% of the tonnage handled by all Florida ports.

To assess the characteristics of port activities over a period of time, the volumes of freight tonnage were examined by commodity for the years shown in Table 2. In 1960-78, the major cargo was liquid bulk commodities such as gasoline, fuel oil, crude petroleum, and liquid sulphur. Although the port also has maintained a diversified mix of general cargo, the most stable base of its operation is liquid bulk. In 1960, for example, 32% of the tonnage was gasoline. In 1978, the gasoline tonnage increased from 253,000 to 387,000 (5.3%) and liquid sulphur tonnage increased to 606,000 tons. Total liquid bulk commodities in 1978 was 2,446,333 tons, 80% of the port's total volume.

Table 2. Port of Pensacola annual freight tonnage in 1960-78 (Adapted from Florida Department of Transportation 1978a).

Year	Tons	Percent change in 1960-78
1960	792,000	--
1965	651,000	-18
1970	1,002,000	+26
1975	2,262,000	+186
1978	3,064,000	+287

Forecasts of general cargo and crude oil imports for the Port of Pensacola were made by the Florida Department of Transportation (1978a). In general, these forecasts are based upon the port's share of Florida waterborne commerce, annual growth rates of cargo volumes, Florida, U.S., and world economic trends, and assessments of competition between Florida and other U.S. ports. The general cargo forecasts for Pensacola are shown in Table 3.

Table 3. Port of Pensacola general cargo forecast in tons (Florida Department of Transportation 1978a).

Category	1980	1985	1990	2000
Foreign Imports	43,000	45,000	48,000	52,000
Exports	113,000	153,000	191,000	266,000
Domestic Shipments	34,000	36,000	38,000	40,000
Receipts	78,000	90,000	101,000	122,000
Total	268,000	324,000	378,000	480,000

The forecasts for crude oil imports for the port of Pensacola are 750,000 short tons in 1985, 900,000 tons in 1985, and one million tons in 1990, 1995, and 2000 (Olsen 1981). The Port of Pensacola and Port Everglades are the only Florida ports handling significant volumes of crude oil. Pensacola's crude oil tonnage has been changed to foreign imports in the account of the Belcher Oil Company.

Panama City

The Port of Panama City is on a 19.4-ha (48-acre) site on the northeast side of St. Andrews Bay in Bay County. The channel maintained for access to the Gulf is about 33 ft deep and 400 ft wide. Other means of access to the port are the Intracoastal Waterway, the Atlanta and St. Andrews Bay Railroad, Bay County Airport, and local highways.

The covered cargo storage capacity in 1976 was 327,895 ft^3 of covered storage, and a bulk petroleum storage capacity of 1,235,828 barrels. Ship berthing facilities consisted of 1,600 ft of public deepwater wharves maintained at a depth of 32 ft, and 2,935 ft of privately operated deepwater wharves. Estimates of annual throughput capacity for the Port of Panama City are shown in Table 4. No estimates on liquid bulk were made for this port.

Table 4. Average annual throughput capacity in short tons in 1960-78 for the Port of Panama City (Florida Department of Transportation 1978a).

Terminals and type of cargo	Capacity
Deep Draft Terminal	
General cargo	
Ship/apron transfer	324,000
Covered storage	454,000
Open storage	730,000
Rail/storage transfer	524,000
Dry bulk (peanuts)	156,000
Barge Terminal	
General cargo	
Ship/apron transfer	247,000
Covered storage	173,000
Open storage	243,000
Dry bulk (various)	
Barge/storage transfer	251,000
Storage	15,000

General cargo capacity at the barge terminal was 173,000 tons, and the deep draft terminal capacity was 324,000 tons, well in excess of the 1976 cargo of about 228,000 tons. Dry bulk capacity was restricted by the lack of silo storage.

The Port of Panama City maintained a fairly constant level of waterborne commerce in 1965-78. In 1960-70, Panama City moved a higher volume of freight than Pensacola, but in the 1970's the tonnage at Pensacola was highest. In 1975, Panama City's volume of waterborne commerce of 1,616,000 short tons accounted for 2.0% of the tonnage of all Florida ports. A summary of the percent increase in annual tonnage at Panama City since 1960 is shown in Table 5.

Table 5. Port of Panama City annual freight tonnage in 1960-78 (Adapted from Florida Department of Transportation 1978a).

Year	Tons	Percent increase
1960	1,069,000	-
1965	1,443,000	35.0
1970	1,635,000	52.9
1975	1,616,000	51.2
1978'	1,585,000	48.3

The major cargo of Panama City's port has consistently been bulk wood products (chips and pulp), paper products, and gasoline and fuel oils. Domestic gasoline imports account for much of the volume. In 1960-1978, imports were about 500,000 tons per year, or about 40% of the port's total annual tonnage. Forecasts of general cargo volumes for the port are given in Table 6.

Table 6. Port of Panama City general cargo tonnage forecast for selected years, 1980-2000 (Florida Department of Transportation 1978a).

Category	1980	1985	1990	2000
Foreign				
Imports	27,000	29,000	28,000	32,000
Exports	331,000	459,000	583,000	828,000
Domestic				
Imports	26,000	29,000	32,000	39,000
Exports	178,000	226,000	286,000	360,000
Total	562,000	743,000	929,000	1,259,000

Port St. Joe

The Port of St. Joe is on the east shore of St. Joseph Bay in Gulf County. Access to the Gulf is provided by a channel 35 ft deep and 300 to 500 ft wide. Other means of access to the port are provided by the Intracoastal Waterway (via the Gulf County Canal), the Apalachicola Northern Railroad, and U.S. Highway 98. This port consists of a deepwater wharf approximately 2,600 ft long, which accommodates one public and two privately operated terminals. The private terminals are operated by the St. Joe Paper Company and the Hess Oil Company.

In 1960-78, the port's cargo volume fluctuated widely. In 1975, Port St. Joe moved 463,000 tons of cargo or 0.6% of the State total. No estimates of its throughput capacity were made by the Florida Waterport Systems Study (Florida Department of Transportation 1978a). A summary of the changes in annual port tonnage in 1960-78 is shown in Table 7.

Table 7. Port of St. Joe annual freight tonnage in selected years, 1960-78 (Florida Department of Transportation 1978a).

Year	Tons	Percent decline 1960-78
1960	1,620,000	---
1965	255,000	-84.3
1970	932,000	-42.5
1975	463,000	-71.4
1978	657,000	-59.4

In 1960, the port of St. Joe moved 1,142,000 tons of gasoline as domestic receipts, but virtually all of this business was lost to the ports of Pensacola and Panama City by 1965. Receipts of fuel oil surged briefly in 1970, but by 1978 annual tonnage had decreased from 705,000 tons to 80,000 tons. The port's increase in annual tonnage from 1975 to 1978 was primarily due to crude petroleum imports. Port St. Joe currently is a bulk liquid cargo port subject to fluctuations in commodity type.

General cargo forecasts for Port St. Joe show modest increases in cargo volume made up largely by paper products and chemicals (Table 8).

Table 8. Port of St. Joe general cargo forecasts (in tons) for 1980, 1985, 1990, and 2000 (Florida Department of Transportation 1978a).

Category	1980	1985	1990	2000
Foreign				
Imports	0	0	0	0
Exports	45,000	61,000	79,000	108,000
Domestic				
Imports	10,000	12,000	13,000	16,000
Exports	0	1,000	1,000	1,000
Total	55,000	74,000	93,000	125,000

AIR TRANSPORTATION

TYPES OF AIRPORTS

The seven county region contains three commercial and nine smaller public airports. These public airport facilities are listed by type and county in

Table 9. Inventories of facilities in the following sections were taken from Florida airports (Florida Department of Transportation 1981). The history and projections of annual air carrier passenger enplanements for commercial airports is given in the next section on airport activity. No heliport or sealane facilities are available among the airports.

Table 9. Airports in Northwest Florida (Florida Department of Transportation 1981).

County	Name	Type
Bay	Panama City-Bay County	Commercial
Escambia	Pensacola Regional	Commercial
	Coastal	General
	Ferguson	General
Franklin	Apalachicola Municipal	General
	Carrabelle Flight Strip	General
Gulf	No facilities	
Okaloosa	Eglin Air Force Base	Joint commercial and military
	Bob Sikes	General
	Destin, Fort Walton Beach	General
Santa Rosa	Fort Walton Beach	General
	Miltion "T" Field	General
Walton	DeFuniak Springs	General

Panama City-Bay County

This airport is 4 mi northwest of Panama City and is the major commercial facility serving the Bay County area. In 1980, the airport had paved runways of 6,004 ft and 4,824 ft). In 1980, the field served six daily commercial airline flights.

Pensacola - Escambia Coastal

This airport is located 12 miles northwest of Pensacola in Escambia County. In 1980, the runway was 2,500 ft long and turf surfaced, and served daily commercial airline flights.

Ferguson

This general aviation airport is 5 miles southwest of Pensacola in Escambia County. In 1980, the turf runway was 2,600 ft long.

Pensacola Regional

This airport, located 3 miles northeast of Pensacola, is the major commercial facility serving the Escambia County area. In 1980, the airport had paved runways of 7,000 ft and 6,000 ft and was served by 14 daily commercial airline flights.

Apalachicola Municipal

The Apalachicola Municipal Airport is located 2 miles west of Apalachicola in Franklin County. In 1980, this general aviation facility had three paved runways, each 5,200 ft long.

Carrabelle Flight Strip

The Carrabelle Flight Strip, also serving Franklin County, is located 2 miles west of Carrabelle. Few services are provided at this airport, but it does have a 400-ft paved runway.

Bob Sikes

The Bob Sikes Airport is located 3 miles northeast of Crestview in Okaloosa County. This general aviation facility has 8,000 ft of paved runway.

Destin-Fort Walton Beach

This airport, 1 mile east of Destin in Okaloosa County, has a paved runway of 5,000 ft. The Destin-Fort Walton Beach airport is the busiest general aviation facility in Northwest Florida. About 60 private aircraft are based there.

Eglin Air Force Base

Eglin Air Force Base includes a public terminal operated by the Okaloosa Board of County Commissioners. The airport is 1 mile southwest of Valparaiso and has paved runways of 10,000 ft and 12,000 ft. In 1979, there were 13 daily commercial airline flights. Prior arrangement must be made for permission for private planes to land at this field. Approval is unlikely unless a need is established and special insurance requirements are met.

Fort Walton Beach

The Fort Walton Beach airport is a small general aviation facility located 2 miles east of Navarre in Santa Rosa County. A turf runway of 2,300 ft is maintained.

Miltion "T" Field

This airport is the busiest general aviation facility in Santa Rosa County. The field is located 2 miles east of Milton and has a paved runway of 3,700 ft long.

DeFuniak Springs

DeFuniak Springs Airport is located 2 miles west of the city on U.S. Rt. 90. It is the only general airport in Walton County and has a paved runway of 3,200 ft.

AIRPORT OPERATIONS

To establish the level of activity among the airports in Northwest Florida, Standard FAA workload measures were employed. The basic measure for commercial airports is the number of enplaning passengers per year. Past and projected passenger enplanements for the commercial airports are shown in Table 10.

Commercial airline forecasts were made by the Florida Department of Transportation as part of the Florida Aviation system Plan (Florida Department of Transportation 1975). The forecasting employed (1) correlation analysis (population history with enplanement history), (2) share of the marked regional enplanement history with U.S. enplanement history, and (3) linear fit (regional enplanements with regional population). The variables used were population, payroll, and tourist accommodations. These forecasts, shown in Table 10 predict that the Pensacola Regional Airport will be the dominant and fastest growing airport in Northwest Florida from 1980 to 1990. Growth is based on the number of takeoffs and landings per year (aircraft operations).

Table 10. Number of past (1960, 1965, 1970, and 1974) and predicted (1980, 1985, 1990) air carrier enplanements for commercial airports in Northwest Florida (adapted from Florida Department of Transportation 1975).

Year	Panama City-Bay County	Pensacola Regional	Eglin A.F.B. Commercial
1960	13,369	47,263	11,798
1965	29,489	86,671	26,102
1970	47,760	165,580	69,700
1974	74,046	187,239	96,616
1980	137,100	400,000	172,700
1985	205,100	650,000	261,600
1990	288,200	1,000,000	372,300

Historical and predicted annual aircraft operations for the general aviation airports for Northwest Florida are shown in Table 11. Future operation levels are taken from Federal Aviation Administration (FAA) Aviation Forecasts (U.S. Department of Transportation 1979). The procedure used was to apply the FAA forecasted growth percentage (42%) for general aviation aircraft operations from 1979 to 1991 for Northwest Florida and then allocate this growth based on each airport's market share of operations reported for 1979. Only Ferguson and Destin-Fort Walton Beach are expected to exceed 50,000 operations

per year. The reductions of number of operations reported at many of the airports between 1972 and 1979 are believed by the Florida Department of Transportation (DOT) to be caused by increasing fuel costs.

Table 11. The number of aircraft operations in 1972 and 1979, and projected to 1981 and 1991 among general airports in Northwest Florida (adapted from Florida Department of Transportation 1981).

Airport	1972	1979	1981	1991
Coastal	16,650	9,000	9,800	12,700
Ferguson	80,000	55,000	60,300	78,100
Apalachicola Municipal	20,000	2,100	2,100	2,700
Carrabelle Flight Strip	1,800	2,000	2,100	2,700
Bob Sikes	20,405	30,000	33,000	42,700
Destin-Fort Walton Beach	100,000	75,000	82,300	106,500
Fort Walton Beach	2,000	7,000	7,700	10,000
Milton "T" Field	32,500	24,000	26,400	34,200
DeFuniak Springs	16,900	9,000	9,800	12,700
Total	290,255	213,100	233,700	302,600

RAIL TRANSPORTATION

RAIL SYSTEMS

The railroads serving Northwest Florida are freight lines. Two are Class 1 (net annual operation revenues of $10,000,000 or more: the Louisville and Nashville Railroad Co., and the St. Louis-San Francisco Railroad Co.), and two are Class II (Apalachicola Northern Railroad Co. and Atlanta and St. Andrews Bay Railroad Co.). Class II includes terminal companies, switching companies, and the short lines (see Figure 2). Few details are available for analysis of railroad operations in Northwest Florida and no projections have been made for the future. Descriptions of the four railroads are given in the following subsections.

CLASS I RAILROADS

The Louisville and Nashville Railroad, part of the Family Lines System, is headquartered in Jacksonville. It is the major railroad in Northwest Florida and serves the Port of Pensacola. The railroad has 3,100 route miles in Florida and connects with all other lines operating in the State. In 1979, approximately 400,000 rail freight cars were moved by the Louisville and Nashville Railroad on Pensacola trackage. Of these, about 21,000 were interchanged with the St. Louis-San Francisco Railroad which also serves the Port of Pensacola. The remainder of the traffic (approximately 350,000 cars annually) were through the line's Jacksonville to New Orleans link. Total

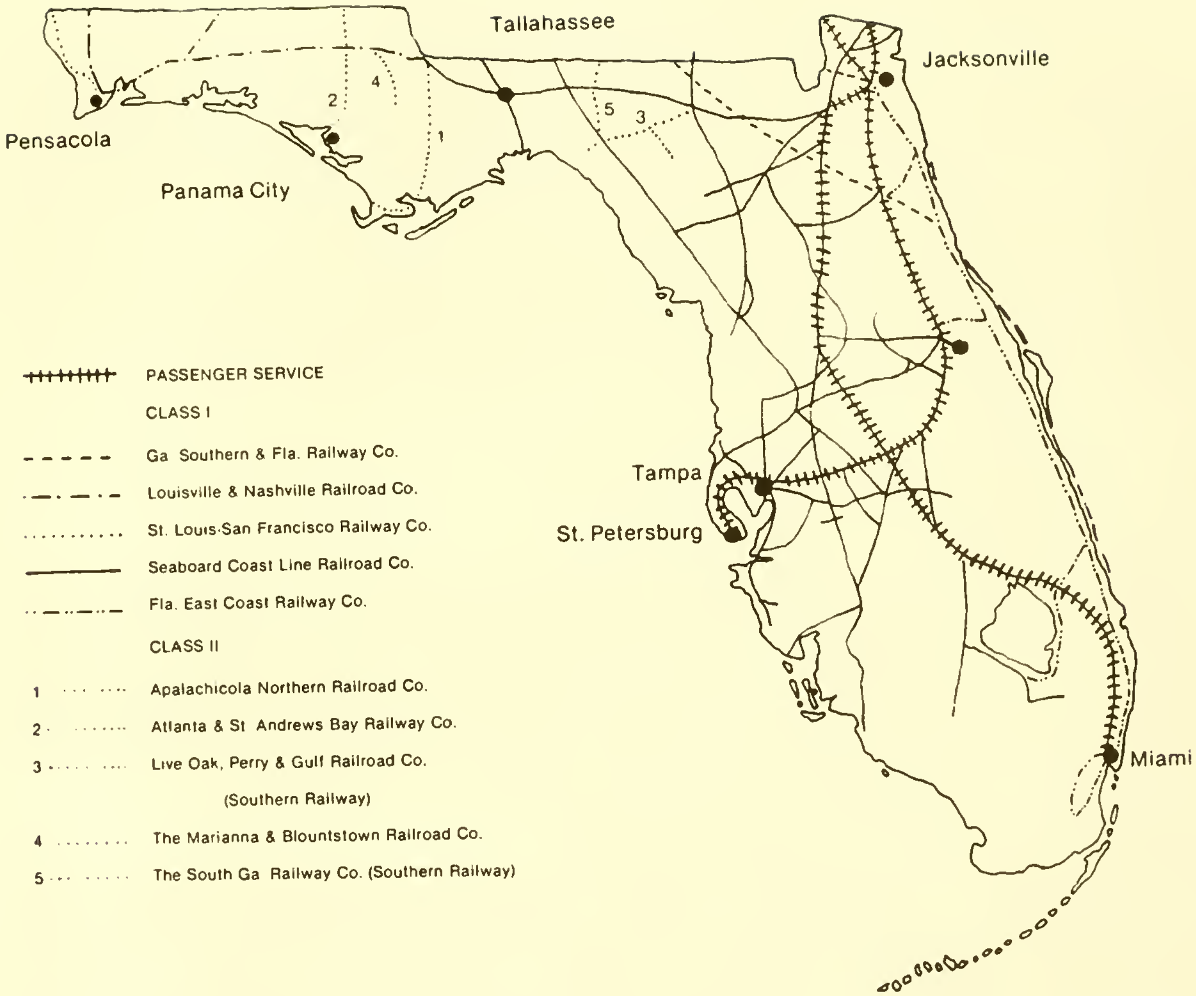

Figure 2. Passenger and freight railroads in Florida (Florida Department of Transportation 1978a).

freight tonnage carried by the Louisville and Nashville in 1976 was about 6,996,465. The Florida State Rail Plan shows that the Louisville and Nashville Railroad had 1,006 locomotives, 66,667 freight cars, and 6,267 piggyback truck tractor trailers at their disposal (Florida Department of Transportation 1981b). The Louisville and Nashville Railroad reported operating revenues of $14,257,000 and operating expenses of $11,036,000 for its Florida operations in 1975.

St. Louis-San Francisco Railroad Co.

The St. Louis-San Francisco Railroad Co., with general offices in St. Louis, MO, serves Pensacola with a line entering the State near Atmore, AL. The line operates only 45 miles of route in Florida as part of its 4,800-mile system but is the only railroad in the State offering single line service to Arkansas, Missouri, Kansas, Oklahoma, and Texas. A trailer-on-flatcars ramp provides piggyback service in Pensacola. The St. Louis and San Francisco Railroad Company along with the Seaboard Coast Line, Union Pacific, and Burlington Northern is probably the longest railway runthrough (Miami to Seattle) in the country. The railroad reported revenues of $1,124,000 and operating expenses of $879,000 for its Florida operations in 1975.

CLASS II RAILROADS

Apalachicola Northern Railroad

This carrier has its principal terminal at Port St. Joe and joins the Seaboard Coast Line and Louisville and National Railway Co. at Chattahoochee in Gadsden County, Alabama. The principle inbound commodity (up to 80 carloads per day) is pulpwood for the paper industry in Port St. Joe. Outbound shipments are primarily paper products. The 96-mile line to Chattahoochee is operated by the Port St. Joe Paper Co. In 1975, the railroad reported operating revenues of $3,203,000 and operating expenses of $1,511,000.

Atlanta and St. Andrews Bay Railway Company

This company, headquarterd in Dothan, Alabama, operates 81 miles of track between Panama City and Dothan, entering Florida near Cambelton. The railroad serves the Port of Panama City and connects with the Family Lines System at Cottondale and Graceville, Florida, as well as at Dothan. The Atlanta and St. Andrews Bay Railroad Company is controlled by the International Paper Co., and its Florida operation in 1975 brought revenues of $5,496, 000 and incurred operating expenses of $3,513,000.

HIGHWAY TRANSPORTATION

MAJOR NETWORKS

The locations of Interstate Highways in Florida are shown in Figure 3. Within the northwest Florida region, I-10 is the major east-west highway facility. This four-lane highway connects Northwest Florida with Jacksonville to the east and Mobile and New Orleans to the west. Because of its proximity

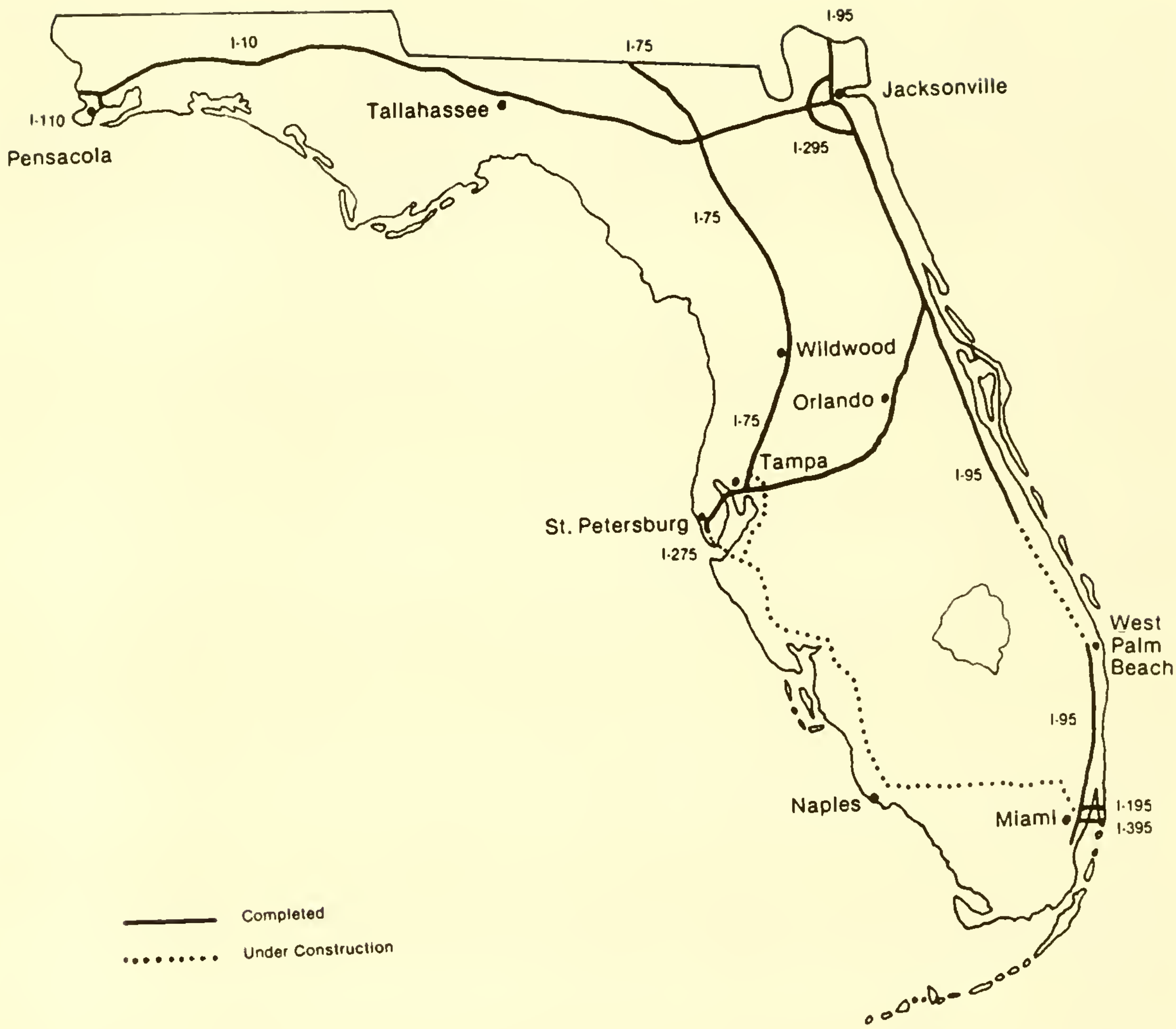

Figure 3. Florida highways (Florida Department of Transportation 1978b).

to I-10, Pensacola is better served by highways than any other port city in the region. Descriptions of the highway systems in each county are given in the following subsections.

Escambia County

In addition to I-10, Escambia County is served by east-west highway U.S. 90 and U.S. 98. Outside of the Pensacola urban area, these highways have two-lane sections which restrict their capacity at level of service C (Highway Capacity Manual 1965), which is under 10,000 vehicles per day. For comparison, the capacity of I-10 at level of service C is just under 30,000 vehicles per day. Level of service C is defined as a traffic volume to capacity situation wherein traffic flow is restricted, causing a reduction in travel speed. The major north-south highway serving the county is U.S. 29, which connects Pensacola with Montgomery, AL.

Santa Rosa County

Santa Rosa County and Escambia County have the same major east-west arterials. Along the gulf coast, U.S. 98 is heavily used by tourists and generally avoided by through truck traffic. Since the completion of I-10 in the 1970's, both truck and auto traffic have been diverted from U.S. 90, which used to be the major truck route. The north-south highways in the county are all two lane and lightly traveled.

Okaloosa County

This county has essentially the same highway network characteristics as Santa Rosa County. Except for a multilane section of SR-85 linking Crestview, I-10, and Fort Walton Beach, north-south travel is generally light on circuitous two-lane roads.

Walton County

In addition to I-10, US-90, and US-98, Walton County is served by SR-20, which links Valparaiso and Niceville with Tallahassee. US-331 is the major north-south route linking DeFuniak Springs with Montgomery, Alabama.

Bay County

Major east-west arterials in Bay County are SR-20 to the north and US-98 along the gulf coast. The major north-south route is US-231, which links Panama City with I-10 and US-90 near Mariconna, and continues north to Dothan, Alabama.

Gulf County

Port St. Joe is linked to I-10 and US-90 at Marianna by SR-71. Along the gulf coast, US-98 is the westbound link to Panama City and the eastbound link to Apalachicola.

Franklin County

Franklin County is linked to Tallahassee by US-98 and US-319. Other north-south travel in the county is extremely light and limited by narrow, circuitous roads.

ROADWAY CHARACTERISTICS

In developing a highway inventory, the descriptive variables selected were roadway width, average daily traffic volume, and capacity at level of service C. The problems with such an inventory is that these characteristics are generally changing along a given route according to localized variations in travel demand and intersecting traffic flows. The inventory of roadway characteristics in Table 12, therefore, is only descriptive of selected route locations in each county.

The roadway widths shown in Table 12 represent the minimum found for each route in each county. Generally, these minimum widths are encountered in rural sections of the counties. These narrow roadway sections are bottlenecks for inter-county travel.

To indicate the relative use of the roadways in each county, a traffic volume range was produced. The low volumes generally correspond to the average daily traffic reported by the Florida Department of Transportation (DOT) on the narrow rural sections of roadway described above. The high volumes are encountered in towns or at major intersections. In these cases, the roadway widths are generally greater than those shown in the table.

Capacity computations were based upon procedures documented in the Highway Capacity Manual (Transportation Research Board 1965). The basic parameters applied to minimum roadway width in determining roadway capacities were level of service C, 10% trucks, level terrain, peak hour traffic equalling 12% of average daily traffic, and a 60%/40% directional split.

The 1977 low traffic volumes and capacities in Table 12 show that US-98 in Bay County is by far the most congested highway in Northwest Florida. In Escambia, Okaloosa, Santa Rosa, and Walton Counties, the reductions of traffic volume on US-90 demonstrate the diversion of traffic to I-10.

Historical changes in traffic volumes at spot locations in the State are documented by permanent traffic recording stations maintained by the Florida DOT. The average daily traffic volumes reported at the nine permanent recording stations are shown in Table 13. The effect of highway improvements in the area is reflected by numerous reductions in traffic volume observed between 1975 and 1980.

TRAFFIC VOLUME FORECASTS

The Florida DOT has studied traffic volume changes in each of the counties in Florida since 1929. These observed changes were correlated with county population and motor vehicle registrations. The result of this analysis was a set of growth factors, specific to each county, used to estimate future traffic.

Table 12. Highway characteristics and volume (vehicle counts) of average daily traffic in 1965 and 1977 (Florida Department of Transportation, Division of Transportation Planning, unpublished records).

County	Highway number	Direction	Minimum width (ft)	Vehicle counts (range) 1965	Vehicle counts (range) 1977	Capacity level C
Bay	SR-20	EW	24	1,300	500 to 2,700	9,400
	SR-77	NS	24	1,600 to 4,000	3,300 to 10,100	9,400
	SR-79	NS	24	700 to 1,100	1,300 to 2,000	9,400
	US-98	EW	22	2,000 to 10,800	11,600 to 20,300	8,800
	US-231	NS	48	1,500 to 4,000	3,200 to 12,100	29,200
Escambia	SR-97	NS	20	1,500 to 2,000	1,300 to 3,300	8,100
	US-29	NS	24	--- ---	5,600 to 37,900	9,400
	US-90	EW	24	5,200 to 20,600	800 to 12,500	9,400
	US-98	EW	20	2,400 to 12,700	6,200 to 28,900	8,100
	I-10	EW	48	900 to 3,100	10,200 to 13,200	29,200
Franklin	SR-55	NS	18	--- 200	--- 500	7,100
	SR-67	NS	18	--- ---	--- 500	7,100
	US-98	EW	20	1,000 to 1,700	1,300 to 3,100	8,100
	US-319	NS	24	--- 400	--- 700	9,400
Gulf	SR-22	EW	20	500 to 1,700	1,800 to 1,800	8,100
	SR-71	NS	22	1,300 to 1,300	1,600 to 3,000	8,800
	SR-386	EW	18	50 to 300	--- 500	7,100
	US-98	EW	24	900 to 6,000	2,300 to 7,100	9,400
Okaloosa	SR-4	EW	20	--- 500	--- 800	8,100
	SR-85	NS	24	1,500 to 4,000	2,200 to 7,000	9,400
	SR-285	NS	18	900 to 2,200	--- 1,300	7,100
	US-90	EW	24	4,100 to 6,500	1,300 to 7,000	9,400

(continued)

Table 12. Concluded.

County	Highway number	Direction	Minimum width (ft)	Vehicle counts (range) 1965	Vehicle counts (range) 1977	Capacity level C
Okaloosa	US-98	EW	24	4,000 to 10,100	9,100 to 21,400	9,400
	I-10	EW	48	--- ---	5,600 to 6,800	29,200
Santa Rosa	SR-4	EW	20	500 to 1,800	800 to 1,600	8,100
	SR-87	ES	20	900 to 5,900	1,500 to 6,700	8,100
	SR-89	NS	20	700 to 900	2,100 to 3,000	8,100
	US-90	EW	24	4,000 to 11,800	3,300 to 19,000	9,400
	US-98	EW	48	3,700 to 12,700	5,000 to 28,900	29,200
	I-10	EW	48	--- ---	6,200 to 13,200	29,200
Walton	SR-2	EW	20	100 to 200	500 to 400	8,100
	SR-20	EW	20	3,000 to 4,400	1,300 to 1,700	8,100
	SR-81	NS	24	300 to 500	600 to 800	9,400
	SR-83	NS	20	300 to 1,900	500 to 5,100	8,100
	US-90	EW	24	3,000 to 4,400	1,600 to 2,100	9,400
	US-98	EW	24	2,200 to 2,700	3,700 to 5,100	9,400
	US-331	NS	24	1,000 to 2,100	1,100 to 3,400	9,400
	I-10	EW	48	--- ---	3,100 to 6,100	29,200

Table 13. Average daily traffic volume (vehicle counts) at Department of Transportation permanent traffic recording stations (Florida Department of Transportation, Division of Transportation Planning, unpublished records 1980).

Station	Location	County	1965	1970	1975	1980	Percent change 1975-1980
21	US-98 at Phillips Inlet	Bay	2,685	3,480	4,365	3,610	-17.3
48	US-90 at Perdido River	Escambia	5,190	1,790	1,615	1,878	16.3
51	SR-83 N. of DeFuniak Springs	Walton	1,155	1,490	1,775	1,765	- 0.6
53	US-231, 3 mi. S. of SR-20	Bay	2,645	3,745	--	5,235	--
60	US-98, 5 mi. S. of US-319	Franklin	1,045	1,360	1,875	1,835	- 2.1
82	US-29, N. of US-90	Escambia	--	14,530	13,685	9,724	-28.9
122	US-90, 2 mi. W of SR-85	Okaloosa	--	6,320	5,400	6,126	13.4
156	I-10, 1.5 mi. W of US-90	Escambia	--	5,352	8,720	10,940	25.5
159	US-90, N. of US-90A	Escambia	--	--	--	17,745	--

Growth factors are used by the Florida DOT to estimate future traffic on roads located outside of areas having an ongoing Urbanized Area Transportation Study (UATS). For example, to determine the estimated 1997 traffic volume on SR-20 in Bay County, the 1977 values should be multiplied by 4.204 (Table 14). In Northwest Florida, the only UATS is in Pensacola. Documentation of UATS data collection, modeling, and network assignment procedures and results is maintained by the Florida DOT and the Pensacola Metropolitan Planning Organization.

Table 14. Traffic growth factors at five year intervals (Florida Department of Transportation, unpublished data, 1981).

County	Traffic growth factors			
	5-year	10-year	15-year	20-year
Bay	1.524	2.324	3.264	4.204
Escambia	1.436	2.061	2.780	3.499
Franklin	1.252	1.568	1.912	2.257
Gulf	1.456	2.119	2.886	3.653
Okaloosa	1.436	2.061	2.780	3.499
Santa Rosa	1.497	2.240	3.108	3.976
Walton	1.396	1.949	2.578	3.207

BUS SYSTEMS

The seven counties in Northwest Florida are served by Greyhound and Trailways intercity bus routes. One local public transit system also serves Escambia County. No information on the intercity lines was available other than fares and schedules readily available anywhere.

Local (in city) transit services in Northwest Florida are difficult to justify and maintain due to high operating costs and low demand. Transit services in Fort Walton Beach, Okaloosa County, and Panama City during the 1970's are now out of business.

In 1979, the Escambia County Transit System operated 29 motor buses and carried 1,475,376 passengers. There were 951,860 revenue miles of service and 52,728 vehicle hours of operation. Base fare for Escambia Transit was $0.30, with a half fare discount for elderly and handicapped persons. In 1980, the system carried 1,578,814 passengers, and traveled 927,292 vehicle miles for 63,802 vehicle hours of operation. The fare schedule remained unchanged (Florida Department of Transportation 1980).

A recent modification in Federal funding leaves the future of public transit uncertain. Under the modification, the operating cost subsidy currently funded through the Urban Mass Transportation Administration on half of the local revenue-cost deficit will be phased out during the next three years. Local government options to this funding change are (1) local revenues from other sources will be used to subsidize transit costs, (2) an increase in

fares, (3) cancellation of nonprofitable routes or other reductions, or (4) total abandonment of service. No reliable transit estimates for future operations can be made at this time.

PIPELINE TRANSPORT

PIPELINE NETWORKS

The major pipelines in Northwest Florida are privately owned and serve primarily to transport natural gas. In Santa Rosa County, however, one 625-cm (10-in) Jay to Mobile pipeline operated by EXXON currently serves as a crude oil collection line for the Hay oilfield. Locations of the major pipelines in Florida are shown in Figure 4. The pipeline mileage, flows, and capacities in Northwest Florida are unknown, but the State as a whole is served by 4,750 km (2,952 mi) of transmission lines and 14,207 km (8,839 mi) of distribution lines. In 1975, the Florida consumption of natural gas was 307.3 billion ft^3 mostly provided by pipelines linking the State with natural gas supplies in Texas and Louisiana.

PIPELINE OPERATING CHARACTERISTICS

Three major interstate pipeline companies supply natural gas to Florida. Statistics of the Federal Power Commission and Department of Energy do not give details on gas supply network characteristics or quantities for individual States. Total company operating statistics, each spanning at least three States, are shown in Table TRANS 48, Data Appendix. Since no details at the State or county level are available, the extent of natural gas pipeline system operations in Northwest Florida is obscure. Forecasts of pipeline shipments were not made due to the lack of baseline data.

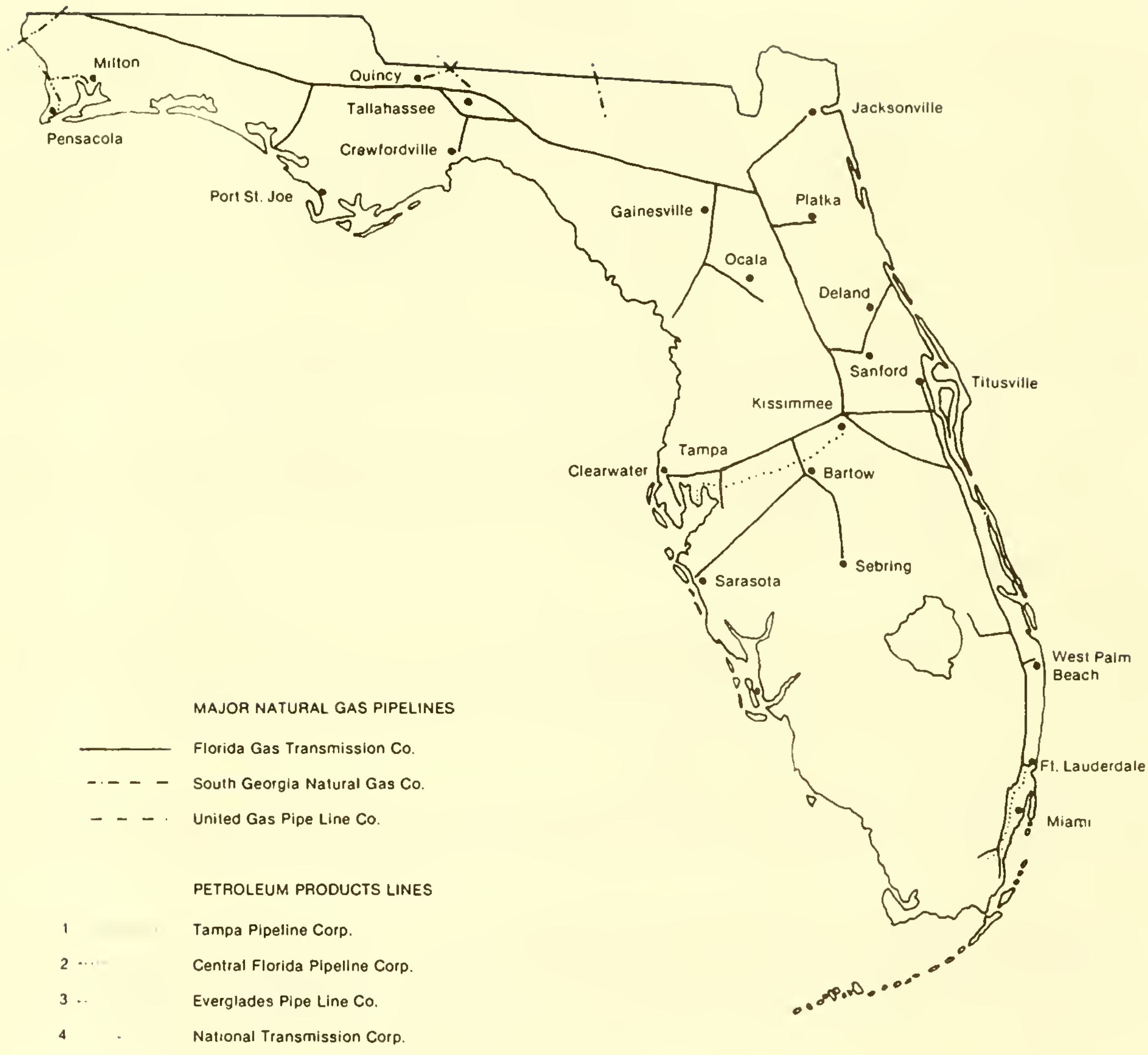

Figure 4. Pipelines in Florida (Florida Department of Transportation 1980b).

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RESIDENTIAL AND INDUSTRIAL DEVELOPMENT

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INTRODUCTION

The coastal resources of Florida are one of its most valuable assets. Most of the urban centers and a large share of its recreational resources are along the coast. Florida has a valuable saltwater fish and shellfish industry, an intracoastal waterway that provides protected routes for waterborne transport of goods and supplies for industry and commerce, and a large electrical generating capacity. Although coastal Florida is where most of the State's economy is centralized, it also is Florida's most vulnerable environment, and is where much of the expanding residential, industrial, and recreational development is taking place.

The competition between economic development and the natural environment is heavy and the natural environment generally is the loser. The public sector has attempted to save natural environments, but environmental losses continue to mount.

Because of the continuing population growth, new economic diversity and expansion necessarily must develop. If Florida's future is to be secure, growth and change must accommodate the natural environment.

The high rate of population growth once was largely in south and central Florida, but now Northwest Florida and other parts of north Florida also are growing rapidly. The seven counties in Northwest Florida are Bay, Escambia, Franklin, Gulf, Okaloosa, Santa Rosa, and Walton. Rapid development is taking place along the coast of these counties.

This report describes the characteristics of residential development in Northwest Florida, especially in urban areas, and the recreation-vacation oriented residential development along the coast. It also describes the characteristics of industrial development and its relationships with residential development and to problems of the natural environment. In addition, the report reviews public utilities, e.g., electrical power generating and distributing systems that support both residential and industrial growth, and which in some ways may be a threat to the natural environment. Domestic sewage treatment capacities in the various counties are described. These areas of concern are reviewed with particular emphasis on their capacity to support

potential Outer Continental Shelf (OCS) oil and gas recovery and its potential effects on residential and industrial development in Northwest Florida.

RESIDENTIAL DEVELOPMENT

Between 1970 and 1980 the percentage growth in housing units in Northwest Florida far exceeded the percentage growth in population. Even so, its resident population increased from 439,793 to 530,429 -- a substantial rise of 20.6%. In these same years, the population growth was about 40% for Florida and about 11% for the Nation. The number of housing units increased 48% in Northwest Florida, 73% in Florida as a whole, and 29% nationally. Because of housing demands, it is important to understand the characteristics of residential development in Northwest Florida, and to determine how housing demands might be affected by onshore demands of OCS oil and gas recovery.

GENERAL NUMERICAL TRENDS

The increase in housing units in Northwest Florida in 1970-80 doubled that of 1960-70 (Table 1), but because of even faster growth in the State as a whole, the percentage of Northwest Florida's units in the State total was 6.8% in 1950 and only 5.8% in 1980.

Table 1. The numbers of housing units in Northwest Florida and in Florida and their increase at 10-year intervals from 1950 to 1980 with Northwest Florida's percentage contribution to the State total given in parentheses (U.S. Department of Commerce 1951, 1961, 1971, 1981a).

	Number (x 1,000)				Numerical increase (x 1,000)		
	1950	1960	1970	1980	1950-60	1960-70	1970-80
Northwest Florida	64.7 (6.8)	112.9 (6.4)	145.4 (5.7)	215.2 (5.8)	48.2 (5.8)	32.5 (4.3)	69.8 (3.8)
Florida	952.1	1,770.0	2,527.6	4,374.8	817.9	757.6	1,847.2

Escambia County has long had the greatest number of housing units in Northwest Florida. In 1950, it had almost half of the units, but in 1980, its share dropped to 41%. The greatest increase in housing was in Okaloosa County, which contributed 10% of the housing units in the region in 1950 and 20% in 1980. Bay County had 20% of the housing in 1980, about the same as 30 years ago.

In 1970-80, Escambia, Okaloosa, and Bay Counties supported about 80% of the housing units in Northwest Florda. These three counties now account for over 174,000 of the over 215,000 housing units. The large share of housing in these counties is further verified by the number of building permits issued in 1975-79 (Figure 1). Apparent is the steady increase in the number of permits issued.

In 1970-80, the numerical increase in housing units was greatest in Escambia County, but its percentage of the Northwest Florida total declined. In 1980, Santa Rosa County had about 20,000 housing units, nearly 10% of the Northwest Florida total. If its share of new units continues to increase for another decade or two, it will become one of the major residential developments in Northwest Florida. Franklin, Gulf, and Walton Counties have shown a slow but steady increase in housing units (Table 2). Except for Cape San Blas in Gulf County, St. George Island and Dog Island in Franklin County, and along the immediate shoreline, other residential development is unlikely in these two counties in the near future.

Table 2. The number of housing units (x 1,000) in each county in Northwest Florida at 10-year intervals in 1950-80, and the percentage increase for each decade (U.S. Department of Commerce 1951, 1961, 1971, 1981a).

County	Number				Percentage		
	1950	1960	1970	1980	1950-60	1960-70	1970-80
Bay	13.6	21.7	27.0	42.9	16.8	16.4	22.9
Escambia	31.3	52.3	55.1	77.6	43.6	39.6	33.8
Franklin	2.3	3.1	3.4	4.5	1.6	0.9	1.6
Gulf	2.3	3.6	3.8	4.7	2.7	0.6	1.3
Okaloosa	6.4	17.9	27.3	43.1	23.9	29.1	22.8
Santa Rosa	4.6	8.7	12.2	20.4	8.5	10.8	11.7
Walton	4.2	5.6	6.6	10.9	2.9	3.1	6.2
Northwest Florida	64.7	112.9	135.4	204.1	---	---	---

DISTRIBUTION

Of the seven counties in Northwest Florida, only Escambia, Bay, and Okaloosa are classified as urban. Since 1950, the population growth has been centered in or near major urban centers. In 1980, the population of Pensacola in Escambia County was 57,130; for Panama City in Bay County it was 33,100; and for Fort Walton Beach in Okaloosa County it was 20,811. Adjacent military bases contribute to the population and economy of each of these urban centers. The Pensacola Naval Air Station employs 18,000 people; Tyndall Air Force Base, located near Panama City, employs 5,700 people; and Elgin Air Force Base, just north of Fort Walton Beach has a work force of 14,000. The Elgin Air Force Base may be the largest (720 mi^2) military base in the world (Miller 1981). Each of the three cities now is exhibiting urban sprawl.

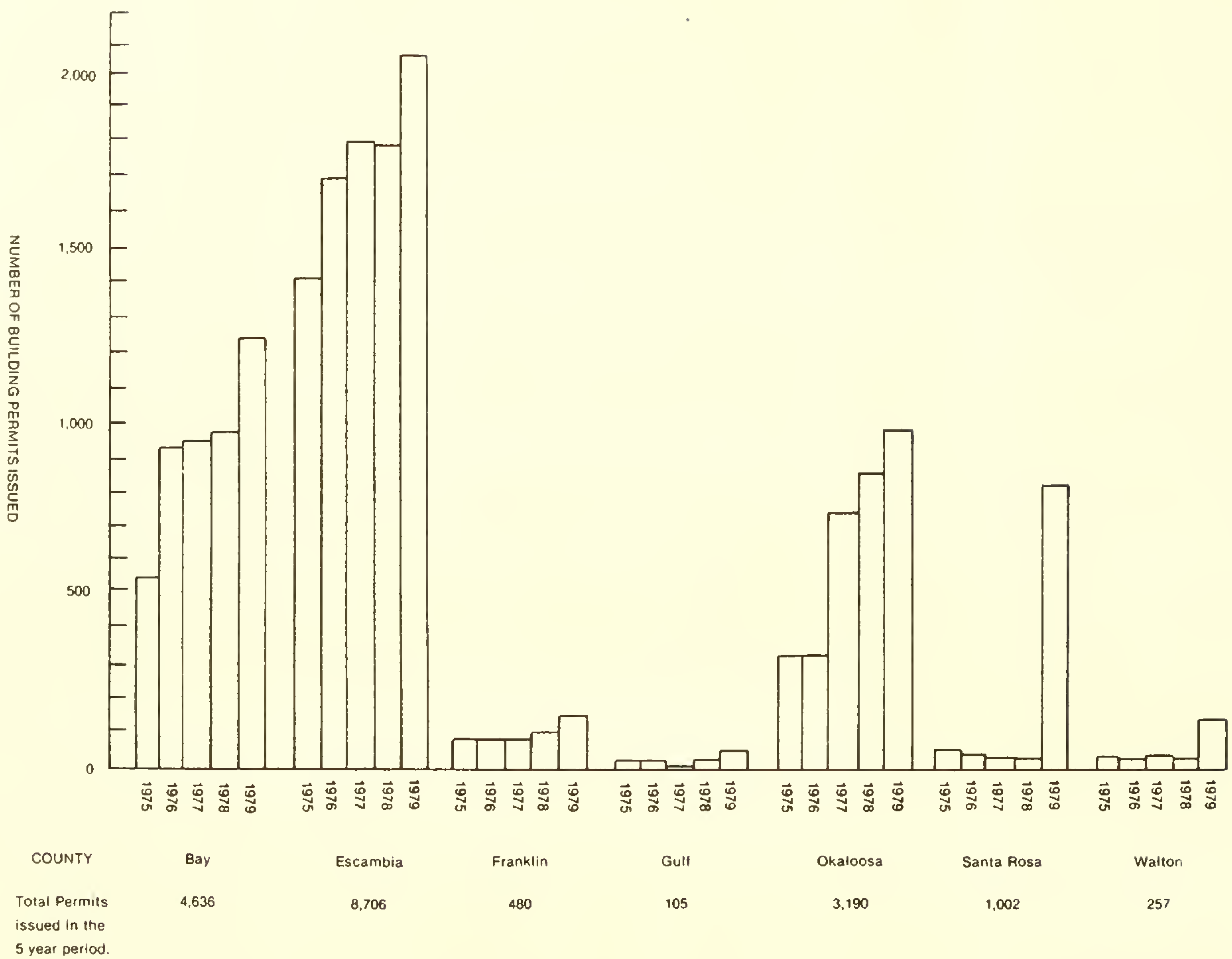


Figure 1. Building permits in the Northwest Florida region for 1975-79 (Florida statistical abstract 1976, 1978, 1980).

Panama City, Pensacola, and Fort Walton Beach are located along the coast where there is a potential for OCS oil and gas development. Initial phases of oil and gas exploration may be more dependent on harbor depth and facilities than on the size of the population. Shallow harbor depths and facilities may limit the location of land-based OCS oil and gas activities to Pensacola, Panama City, Port St. Joe in Gulf County, and perhaps Carabelle in Franklin County.

Before 1970, residential areas spread northward from Pensacola in Escambia County into much of the rest of the county and have extended far enough to almost join Milton in Santa Rosa County (Figure 2). Other residential expansion is evident in the northern part of Escambia County. Data for years after 1970 are not available.

Other residential development was (and still is) either clustered around Fort Walton Beach (Figure 3), Panama City (Figure 4), along the coastline, and along corridors parallel to U.S. Routes 20 and 90.

Many of the residential units along the coast were developed primarily to serve the vacation-home market. In most parts of Florida it is unlikely that vacation units would be available to meet other demands, such as might be associated with the housing needs of OCS development-related workers. But in Northwest Florida, vacation units in winter could be rented to people from the oil companies and suppliers.

TRENDS FOR SPECIFIC TYPES OF DEVELOPMENT

Unlike south and central Florida where there are relatively heavy concentrations of apartments, condominiums, cooperatives and time-sharing (interval) units, Northwest Florida is primarily an area of single family homes. Apartments, condominiums, and other multi-family dwellings there are generally found only in the larger cities or along the beaches. This section on residential development discusses the general characteristics of major types of residences.

Detached Single-family Dwellings

The difference between the percentages of single-family and multi-family dwelling units in Northwest Florida and other areas of Florida may be made by comparing Northwest Florida with Southwest Florida (from Pasco County in the north to Monroe County in the south). In 1975-79, the seven Northwest Florida counties issued 18,476 building permits of which 80% were detached single-family dwellings, whereas in Southwest Florida, 174,304 permits (66% single family) were issued. The rate of residential building in Northwest Florida, heavily skewed toward single-family units, is only about one-tenth that of Southwest Florida.

Insofar as Northwest Florida is concerned, Bay and Escambia Counties, which are the most urbanized counties, had the lowest percentage (about 77%) of building permits issued for detached single-family dwelling units (Table 3). In 1975-79 in Okaloosa County, 87% of the building permits issued were for single-family units. The percentage of permits issued for single-family units in the remaining four counties ranged from 84% in Franklin County to 100% in Gulf County. The average for Northwest Florida was 80%.

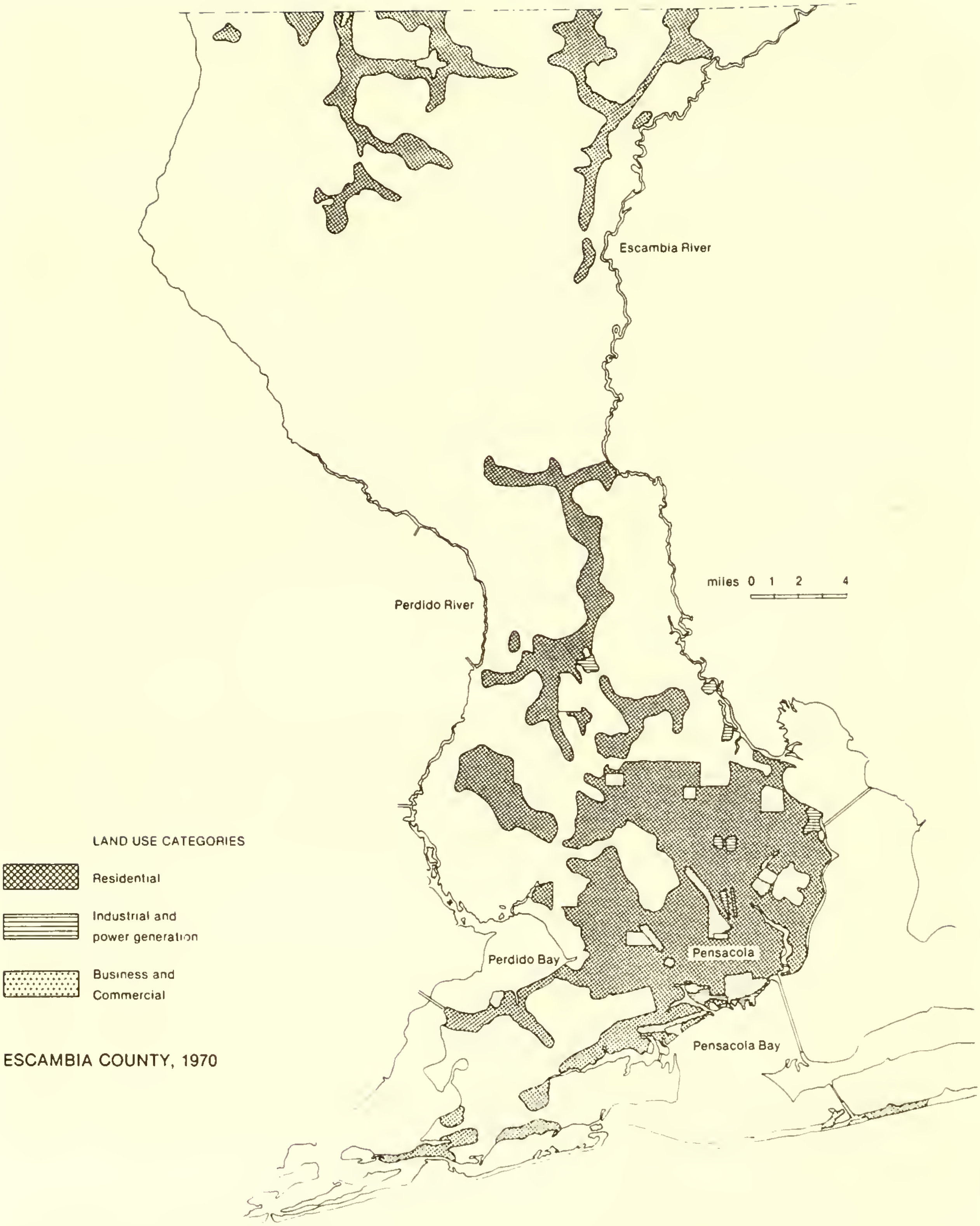


Figure 2. Selected land uses in Escambia County (Florida Coastal Coordinating Council 1970).

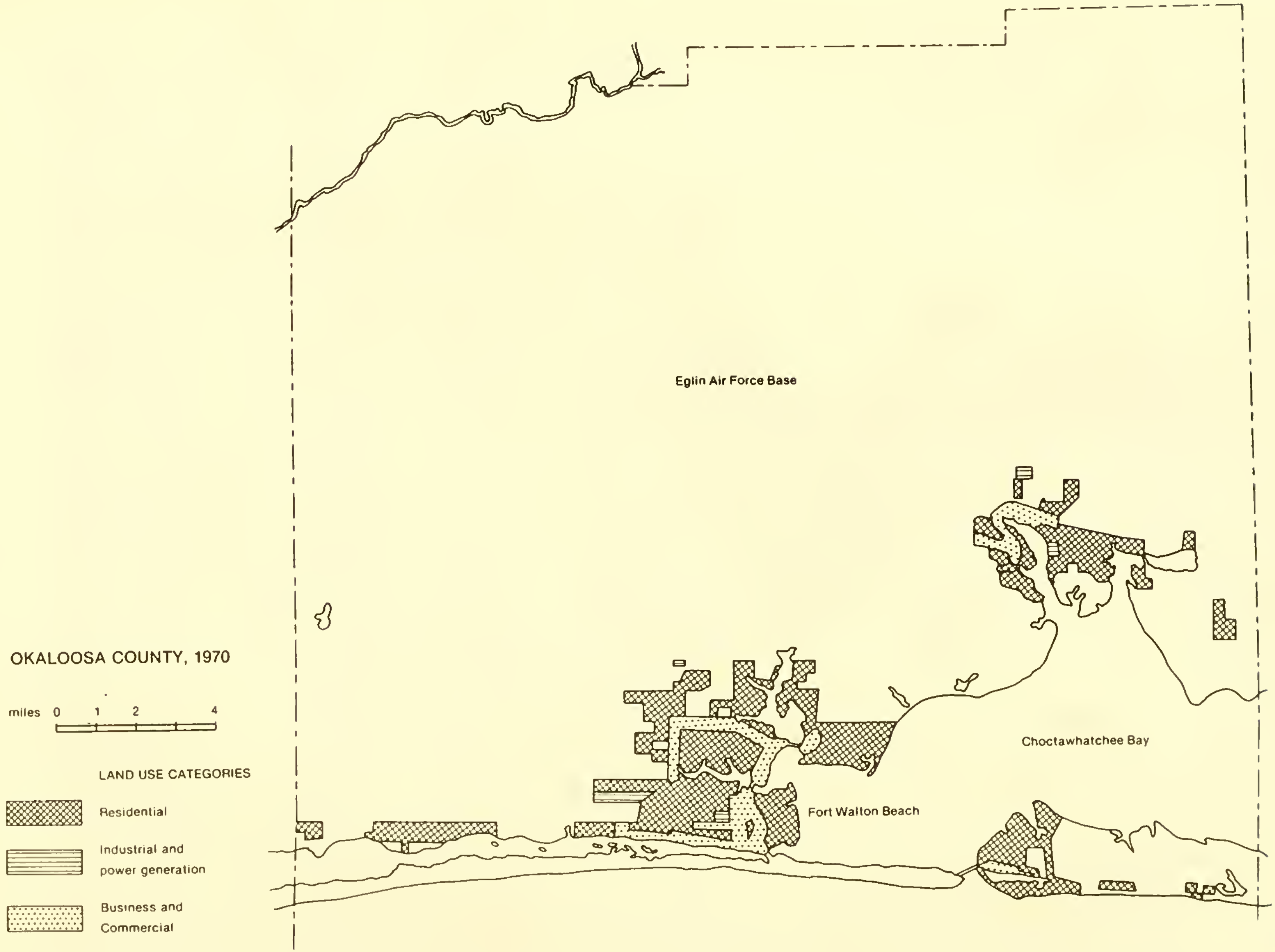


Figure 3. Selected land uses in Okaloosa County (Florida Coastal Coordinating Council 1970).

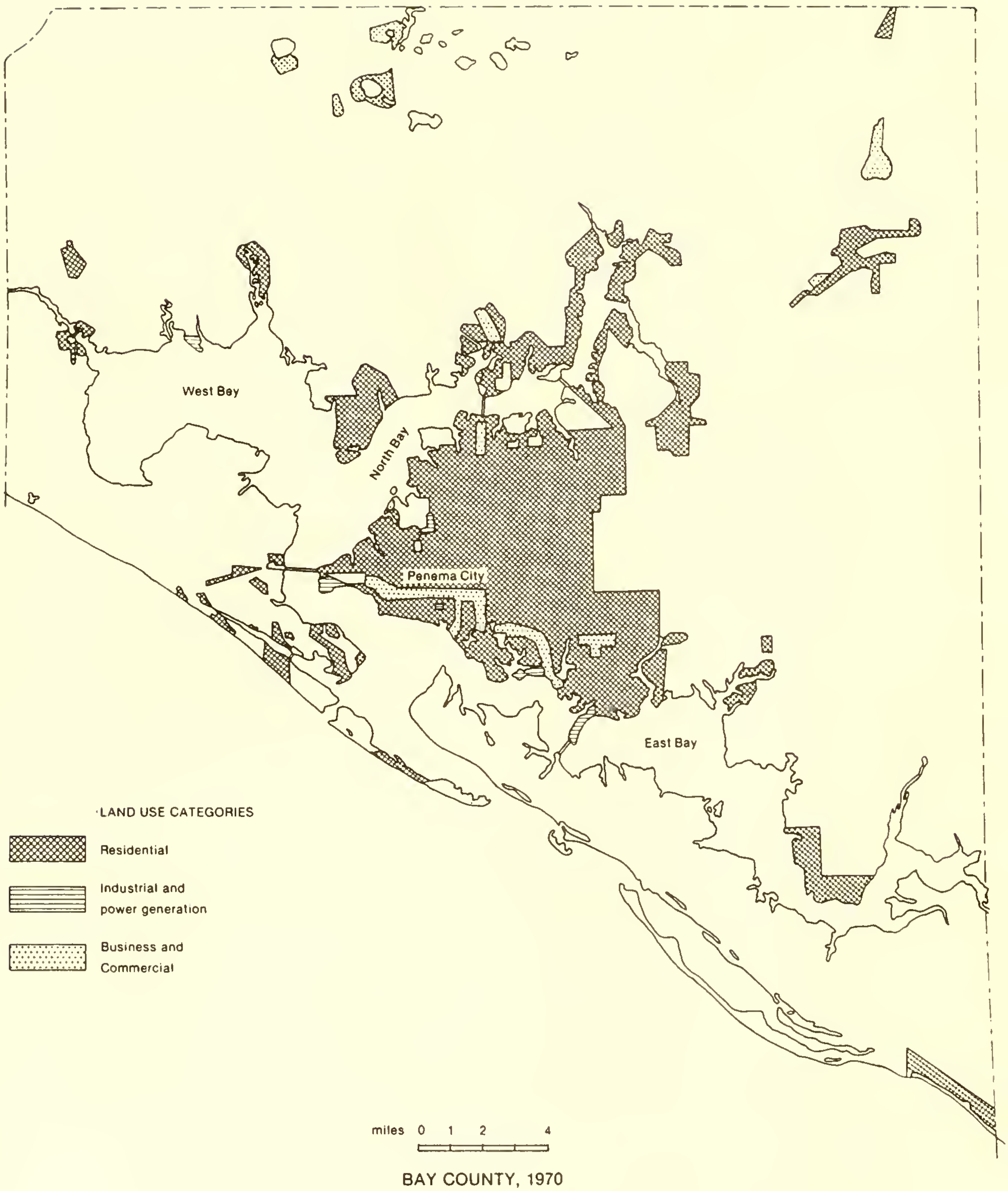


Figure 4. Selected land uses in Bay County (Florida Coastal Coordinating Council 1970).

Table 3. The number of detached single-family building permits issued in 1975-79 (Thompson et al. 1977, 1978, 1979).

County	Number of building permits issued	Percentage of single-family units
Bay	4,636	76
Escambia	8,706	77
Franklin	480	84
Gulf	105	100
Okaloosa	3,290	87
Santa Rosa	1,002	90
Walton	257	99
Northwest Florida	18,476	80

Mobile Homes

Mobile homes are a single-family home, and have become increasingly abundant in Northwest Florida and the State. In 1950, the 624 mobile homes in Northwest Florida contributed only 1% of the housing units. In 1960, the number increased to 4,597 (4% of the housing units) and by 1970 the number reached 11,555 (8%). The percentage contributed by mobile homes to the State total increased from 2% in 1950 to 6% in 1970. The percentage increase of mobile homes among residences increased more than in the State as a whole.

Because of the presence of the Elgin Air Force Base, Okaloosa County in 1970 had the greatest number of mobile homes (Table 4). Escambia County had almost as many mobile homes because it has a naval base and a naval air station as well as the largest urban center (Pensacola) in the region.

No reliable statistics are available for mobile homes after 1970. Since the availability of mobile homes may be important during the early construction phases of OCS oil and gas development, it is important that 1980 census data on mobile homes be incorporated into this study as soon as it becomes avilable. Until then, it is assumed that the number of mobile homes in the 1970's and early 1980's will continued to increase.

Multi-family Dwellings

In recent years, multi-family dwelling units have become more numerous in Northwest Florida. The number of permits issued in 1979 were 1,991 in Escambia County, 1,116 in Bay County, and 426 in Okaloosa County. Only a few were issued in the other counties. A relatively large percentage of all permits issued in 1975-79 in Escambia and Bay Counties have been for multi-family units.

Table 4. The number of mobile homes in Northwest Florida in 1950, 1960, and 1970 (U.S. Department of Commerce 1961, 1971).

County	1950	1960	1970	Percentage of the county total
Bay	168	987	2,577	19.6
Escambia	238	1,672	3,466	5.8
Franklin	7	44	199	5.8
Gulf	8	88	151	4.0
Okaloosa	164	1,375	3,531	13.0
Santa Rosa	27	343	1,166	9.6
Walton	12	88	465	7.0
Northwest Florida	624	4,597	11,555	14.1

Table 5. The number of residential building permits issued in 1975-79 in Northwest Florida and the percentage contribution to the total number of permits issued (Adapted from Thompson et al. 1976, 1978, 1980).

County	Number	Percentage
Bay	4,636	24
Escambia	8,706	23
Franklin	480	16
Gulf	105	1
Okaloosa	3,290	13
Santa Rosa	1,002	10
Walton	257	<1
Northwest Florida	18,476	20

Most of the 76 multi-family units for which permits were issued in Franklin County in 1975-79 were issued in 1979, and most of those were for St. George Island. Less than 1% of the permits issued in Walton and Gulf Counties were for multi-family units.

Because it is likely that residential development will continue to increase in the urban areas and along the beaches of Northwest Florida where there are suitable locations, the percentage of multi-family dwelling units may grow correspondingly, especially in Escambia, Bay, and Okaloosa Counties (Table 5).

OTHER CHARACTERISTICS OF RESIDENTIAL DEVELOPMENT

Several other considerations important to understanding the characteristics of residental development in Northwest Florida are included in the following subsections.

Quality of Housing

In the past, the U.S. Census determined the quality of housing by the number of homes with and without plumbing. In 1970, the three most rural counties had the least adequate plumbing (Table 6). The seven county average of 7.4% is high compared to other areas of Florida (e.g., only 3.5% of the housing units in Southwest Florida lacked adequate plumbing).

Table 6. The number and percentage of year-round housing units without adequate plumbing in Northwest Florida in 1970 (U.S. Department of Commerce 1971).

County	Number	Number lacking plumbing	Percentage
Bay	26,978	1,694	4.4
Escambia	65,141	4,617	7.1
Franklin	3,409	567	16.6
Gulf	3,795	588	15.5
Okaloosa	27,296	1,137	4.2
Santa Rosa	12,515	1,099	9.0
Walton	6,597	1,073	16.3
Northwest Florida	145,731	10,775	7.4

Price Range of Units for Sale

A review of the price range of housing units for sale gives incoming residents a general idea of what proportion of their income must be allocated to housing. The median value of housing units for sale in Northwest Florida has generally been below that for the State as a whole (Table 7). The exception is Okaloosa County in 1970. Although housing values for the region will likely remain lower than the State average, values could rise sharply in the event of OCS related oil and gas development.

Rental Units

In 1970, about one-third of the housing in Florida and in Northwest Florida was rental units (Table 8). Of the seven counties in Northwest Florida, Okaloosa had the highest percentage (40%), largely attributable to the proximity of Eglin Air Force Base. The percentage of units in the two most urbanized counties (i.e., Escambia and Bay) was near the State average.

Table 7. Median value ($) of housing units for sale in Northwest Florida in 1950, 1960, and 1970 (U.S. Department of Commerce 1961, 1971).

County	1950	1960	1970
Bay	---	10,600	9,300
Escambia	7,450	12,400	12,100
Franklin	---	---	---
Gulf	---	---	---
Okaloosa	---	12,400	16,600
Santa Rosa	---	---	10,500
Walton	---	---	7,800
Florida	7,996	13,300	14,400

Table 8. Rental units as a percentage of all housing units in Northwest Florida in 1970 (U.S. Department of Commerce 1971).

County	Percentage
Bay	32
Escambia	31
Franklin	21
Gulf	24
Okaloosa	40
Santa Rosa	28
Walton	20
Northwest Florida	32
Florida	31

Although the average percentage of rentals in Northwest Florida is about the same as in the State as a whole, there are some differences in the type and distribution of the units. In Northwest Florida counties, a greater proportion of the rental units are along the beaches rather than in urban centers and smaller communities. If this is correct, a potentially conflicting demand between vacationers and temporary OCS oil and gas related workers for rental housing could be expected.

Rental Rates

According to the Florida Statistical Abstract (Thompson et al. 1980), rental rates in 1970 in most Northwest Florida counties were below the State

average. The exception was Okaloosa County because of the air force base and the increasing number of recreation-oriented units along the shoreline. Rental rates in 1950-80 in Escambia County have been either at, or just below the State rate. Rental rates for Santa Rosa and Bay Counties increased probably because of more residential development along the coast. Some of the increase, of course, is due to inflation. Rental rates in Franklin, Gulf, and Walton Counties have been low, but only about 6% of their housing is in rental units. If OCS oil and gas related development were to occur anywhere within the region it is likely the demand for rental units would far exceed the immediate supply, and rental rates would soar.

Abundance of Vacancies

Because of insufficient data, it is difficult to properly interpret the percentage of housing vacancies in Florida and to differentiate between vacant seasonal and year-round units. Due to the seasonal variation in tourism, the percentage of vacancies reported may vary considerably depending on the time of year that the housing survey was conducted.

Although Northwest Florida's percentage of housing units in the State has slipped from 6.8% in 1950 to 5.8% in 1970, the percentage increase was greater than the percentage increase in population. This may help explain why the region's share of the State's vacant units increased from 4.1% in 1950 to 6.8% in 1970. Although the number of vacancies in the State decreased in 1960-70, vacancies in Northwest Florida continued to increase, but at a slower rate (Table 9).

The sharp rise in vacancies was apparent in almost every county in 1950-60, and in all counties except Escambia and Gulf in 1960-70 (Table 9). The general increase in vacancy rates may be caused by greater out-migration from the more rural counties or by increased construction of vacation units.

Table 9. The number of vacant units in the counties of Northwest Florida and their percentage contribution (in parentheses) to the total in 1950, 1960, and 1970 (U.S. Department of Commerce 1951, 1961, 1971).

County	1950	1960	1970
Bay	580 (4.2)	1,217 (5.6)	1,417 (5.3)
Escambia	948 (3.0)	2,873 (5.5)	3,037 (4.7)
Franklin	86 (3.8)	102 (3.3)	204 (6.0)
Gulf	84 (3.7)	332 (9.3)	204 (5.4)
Okaloosa	191 (3.0)	884 (4.9)	1,559 (5.7)
Santa Rosa	93 (2.0)	326 (3.8)	683 (5.6)
Walton	26 (0.6)	59 (1.1)	261 (4.0)
Northwest Florida	2,008 (3.1)	5,793 (5.1)	7,365 (5.1)

There are two major differences in trends between vacancies for rent and those for sale. The trends in rental vacancies are a particularly important consideration for workers who would be employed during the construction stage of any potential OCS oil and gas development, whereas the number of housing units for sale gives an indication of capacity to assimilate sudden growth.

In 1950-70, vacancies for rent increased more than vacancies for sale (Table 10). Rental vacancies increased from 1,814 to 5,555, and vacancies for sale increased from 194 to 1,810. Escambia and Okaloosa Counties accounted for more than two-thirds of the increase from 1950 to 1970. In vacancies for sale, all but Walton and Escambia Counties showed sizeable gains.

Table 10. Vacancies for rent and sale in Northwest Florida in 1950, 1960, and 1970 (U.S. Department of Commerce 1951, 1961, 1971).

County	Vacancies For Rent			Vacancies for sale		
	1950	1960	1970	1950	1960	1970
Bay	552	958	1,104	28	259	313
Escambia	825	2,014	2,322	123	859	715
Franklin	76	73	100	10	29	104
Gulf	80	319	164	4	13	40
Okaloosa	164	668	1,209	27	216	350
Santa Rosa	91	203	433	2	123	250
Walton	26	22	223	0	37	38
Northwest Florida	1,814	4,257	5,555	194	1,536	1,810

PROJECTED TRENDS

The projected number of housing units by county in Northwest Florida 1980-2000 were prepared in two steps. First, the 1978 base-year population projections developed by the Bureau of Economic Research at the University of Florida were adjusted to conform to the 1980 population census figures. For example, Bay County had an estimated population of 96,225 in 1978, 124,000 in 1990 and 144,300 in 2000. Since the actual 1980 census figure for Bay county was 97,740, the difference gave an adjusted population projection of 125,700 and 146,100. Secondly, in the projections it was assumed that the average number of persons per housing unit would remain substantially the same as in 1980. For Bay County, there were 2.3 persons per housing unit. This figure was then applied to the projections determined in step one; therefore, the amended projection of the number of housing units for Bay County is 54,700 in 1990 and 63,500 in 2000 (Table 11).

DATA GAPS AND RECOMMENDATIONS

The most glaring gap in the data on residential development was the lack of detailed information on housing from the 1980 census; this information may

Table 11. Projected number of housing units for 1990 and 2000[a] .

County	Persons per housing unit	1980	1990	2000
Bay	2.3	42,900	54,700	63,500
Escambia	2.6	88,661	107,600	125,000
Franklin	1.7	4,497	5,600	6,500
Gulf	2.2	4,741	5,700	6,600
Okaloosa	2.6	43,099	53,600	62,300
Santa Rosa	2.8	20,356	26,200	30,500
Walton	2.0	10,918	13,200	15,300
Northwest Florida	2.5	215,172	226,600	309,700

[a]Projections were derived by taking the number of persons per housing unit (U.S. Department of Commerce) and extrapolating on the basis of population projections in County Economic Data (Florida Department of Commerce 1979).

not become available for months, or even years. The problems are the failure to be able to adequately identify the trends that occurred in 1970-1980, and that accurate projections (except for those of total population and total housing units) cannot be made.

A difficulty regarding residential development analysis is differentiating between housing units for permanent residents and for recreation. Many vacationers rent single-family homes and units in multi-family dwellings by the week, month, or season. Many surveys combine these as housing units without making a distinction.

INDUSTRIAL DEVELOPMENT

Northwest Florida is not heavily industrialized. Most industry is located in or near the coastal cities of Pensacola, Panama City, and Fort Walton Beach. The amount of land suitable for development near urbanized areas is limited because of extensive wetlands, large public land holdings (e.g., Eglin Air Force Base), and because of the hazards of hurricane surge or riverine flooding. Major wetlands and public land holdings are shown in Figure 5. Pensacola has land to the north and west in which to expand, Panama City can grow only eastward because it is surrounded on three sides by bay waters, and Fort Walton Beach can grow little because of Choctawhatchee Bay and Eglin Air Force Base.

Most of the current industrial developments in Panama City and Pensacola are located adjacent to open water or along a river, and are subject to hurricane surge, tidal flooding, and riverine floods. Wastes from industrial, residential, municipal, and recreational developments already have contributed

pollutants that have contaminated oyster beds and caused a closure of shell fishing. Areas affected have been Blackwater Bay, East Bay River, Escambia Bay, and Pensacola Bay in Santa Rosa County; Rocky Bayou in Okaloosa County; Pensacola Bay, Perdido Bay, and Escambia Bay in Escambia County; East Bay, North Bay, St. Andrew Bay, and West Bay in Bay County; and St. Joseph Bay in Gulf County. In addition, the threat of saltwater intrusion because of aquifer drawdowns has become a serious problem in some places, such as Fort Walton Beach (U.S. Army Corps of Engineers 1978).

New development and growth in Northwest Florida will continue to add stress to an already damaged natural environment unless effective land and water management practices are adopted and practiced. Residential and industrial expansion will be difficult to contend with, but if large scale offshore oil and gas recovery becomes a reality, early and adequate planning will be required to safeguard the environment.

The following section describes industrial development from a historical perspective, general site characteristics, projected trends, and potential onshore development of OCS-related facilities.

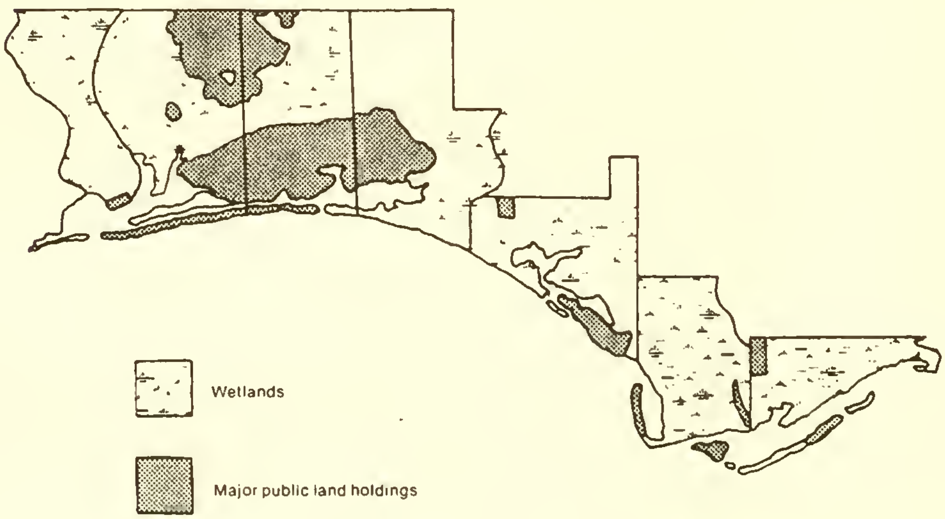


Figure 5. Major public land holdings and wetlands in Northwest Florida (U.S. Army Corps of Engineers 1978).

TRENDS IN GROWTH

Residential development and non-agricultural employment in Northwest Florida increased about 32% in 1972-78, yet according to the Florida Statistical Abstract (Thompson et al. 1978), it has not kept pace with the State's 40% increase. Almost every category of non-agricultural employment has decreased in its share of the State total since the 1950's (e.g., manufacturing decreased from 10% of the State total in 1956 to 5% in 1978). Among the few exceptions was the employment category of employees in hotels and other lodging places; employment there rose from 2.6% of the State total in 1956 to 3.5% in 1978. Employment in contract construction and in eating and drinking places ranged from 4% to 5% of the State total from 1956 to 1978 (Thompson et al. 1978).

Bay County

The Panama City urban area is the second largest industrial area in Northwest Florida. In some Standard Industrial Code (SIC) categories of services (finances, insurance, real estate, communication, retail trade, and manufacturing) employment is increasing at a higher rate than for the State as a whole. Non-agricultural employment has increased most rapidly, but growth in manufacturing was considerably below the State's 64% increase between 1965 and 1978.

In 1978, the greatest number of workers was employed in retail trade (Table 12). A third of these worked in eating and drinking places, and their increase has been about twice that of the State. The difference may be a reflection of the increasing popularity of recreation in Bay County. Further support of this assumption is indicated by the growth in employment in motels, hotels, and other lodging places. This growth is probably linked to growth in tourism, which could be a point of possible conflict between tourist-based interests and the development of any onshore facilities that might be required to support OCS oil and gas activities.

A relatively large number of people are employed by the government in Bay County. In 1979, almost one of every four employed persons worked for the government, mostly at the Tyndall Air Force Base.

Employment in manufacturing has increased gradually in Bay County since 1965. The two major areas of employment in 1978 in manufacturing were paper and allied products (range of 500 to 999 employees) and chemical and allied products (range of 250 to 500 employees). Expansion and the construction of new plants in the county in 1979 and 1980 will probably increase employment.

Escambia County

Although the Pensacola area of Escambia County is the most industrialized area in Northwest Florida, employment in manufacturing decreased in 1965-1978 (Table 13). Although employment in other categories has increased since 1965, the rate of increase is slowing.

The SIC category that showed the greatest number of workers in 1978 was that of retail trade (15,670 employees). Employment in services, which was

Table 12. Numbers of non-agricultural employees in Bay, County in 1956, 1965, and 1978 (Thompson et al. 1980).

Type of employment	Employment[a] 1956	1965	1978	Percent change 1965-78
Construction	893	1,539	2,194	43
Manufacturing paper and allied products	3,563 ---	2,562 ---	3,187 ---[b]	24 ---
Chemicals and allied products	---	---	---[c]	---
Transportation and public utilities	822	931	1,556	67
Communication	---	250	641	156
Wholesale trade	670	759	1,259	66
Retail trade				
Eating and drinking places	2,635 (455)	3,178 (557)	7,530 (2,456)	137 (341)
Finance, insurance and real estate	508	624	1,635	162
Services	1,355	1,698	4,924	190
Hotels/motels[d]	(541)	(476)	1,338	(181)
Health services[d]	(157)	(227)	1,289	(468)

[a]Missing data withheld to avoid disclosure of employment data for some individual establishments.
[b]500 to 999 employees.
[c]250 to 499 employees.
[d]Numbers in parentheses are subcategories.

Table 13. Number of non-agricultural employees in Escambia County in 1956, 1965, and 1978 (Thompson et al. 1980).

Type of employment	Employment[a] 1956	1965	1978	Percent change 1965-78
Mining	---	---	373	---
Construction	2,660	4,579	5,830	27
Manufacturing	9,916	12,372	11,636	-6
Paper and allied products[b]	(2,997)	(2,494)	---[c]	---
Chemicals and allied products	4,914	---	---[d]	---
Transportation and public utilities	2,227	2,604	3,609	39
Communication	505	726	N.D.	---
Wholesale trade	2,208	2,120	3,336	57
Retail trade	6,299	8,252	15,670	90
Eating and drinking places	(1,154)	(1,589)	(4,207)	165
Finance, insurance and real estate	1,270	1,954	3,687	89
Services	2,809	5,322	14,783	17
Health services[b]	(330)	(1,600)	(5,491)	243

[a]Missing data withheld to avoid disclosure of employment data for some individual establishments.
[b]Numbers in parentheses are subcategories.
[c]1,000 to 2,499 employees.
[d]5,000 to 9,999 employees.

the second highest category, increased from 2,809 persons in 1956 to 14,783 in 1978. Half of this growth was in the subcategory of health services, which had 37% of the workers in the category of services. Third in employment among the major employment categories was manufacturing. It was dominated by the subcategory of chemicals and allied products, which employed between 5,000 and 9,999 workers in 1978 (one-half or more of the total employees in manufacturing), and paper and allied products, which accounted for between 1,000 and 2,499 employees.

Escambia County has a large number of government workers, mostly employees of the U.S. Navy.

Franklin County

This county has the smallest number of employed persons in Northwest Florida most of which are employed to process oysters and shrimp in Apalachicola and, to a lesser extent, in East Point and Carabelle. In 1978, 211 people were employed in manufacturing (Table 14). About 80% worked with food and kindred products. The other principal employment categories were retail trade and wholesale trade.

Gulf County

Although data are not available to demonstrate it, industrial employment in Gulf County is greatest in the manufacture of paper and allied products. Port St. Joe and Wewahitchka are centers of the paper and allied products industry. In 1978, the county had between 500 and 999 workers employed in this subcategory of manufacturing (Table 15), but the number of workers employed in manufacturing has steadily decreased since 1956. The number of employees in construction, transportation, and wholesale trade also declined from 1956 to 1978. Services, finance, insurance, and real estate showed increases.

Okaloosa County

Although Fort Walton Beach, Valparaiso, and Niceville are popular tourist centers, they also are heavily influenced by military employment at the Eglin Air Force Base. In 1978, about one-third of all persons engaged in nonagricultural employment worked for the government. The influence of military employment has affected other employment categories as well. For example, employment in the retail trade subcategory increased about fivefold from 1956 to 1978 (Table 16).

In addition to the air force base, the county has extensive recreation-oriented development around Destin. This development has further increased employment in eating and drinking places, hotels, and other lodging places. Consequently, in 1965-78, employment in construction rose at a rate greater than the State average.

Despite a limited area for new development, the economy and population of the coastal area of Okaloosa County is growing rapidly. Growth inland, such as in Crestview, is much slower.

Table 14. Numbers of non-agricultural employees in Franklin County in 1956, 1965, and 1978 (Thompson et al. 1980).

Type of employment	Employment[a]		
	1956	1965	1978
Construction	24	---	---
Manufacturing food and kindred products	58 ---	136 106	211 173
Transportation and public utilities	N.D.	27	52
Wholesale trade	260	288	225
Retail trade	181	204	251
Finance, insurance, and real estate	13	---	85
Services	56	89	77

[a]Missing data withheld to avoid disclosure of employment data for some individual establishments.

Table 15. Numbers of non-agricultural employees in Gulf County in 1956, 1965, and 1978 (Thompson et al. 1980).

Type of employment	Employment[a]		
	1956	1965	1978
Construction	116	73	39
Manufacturing paper and allied products	1,443	1,113	---
Transportation and public utilities	226	164	126
Wholesale trade	79	75	28
Retail trade	283	331	---
Finance, insurance, and real estate	74	47	81
Services	119	93	153

[a]Missing data withheld to avoid disclosure of employment data for some individual establishments.

Table 16. Numbers of non-agricultural employees in Okaloosa County in 1956, 1965, and 1978 (Thompson et al. 1980).

Type of employment	Employment[a] 1956	1965	1978	Percent change 1965-78
Construction	463	1,156	2,115	83
Manufacturing	446	671	2,385	255
Transportation and public utilities	226	581	1,137	120
Communication	---	---	---	---
Wholesale trade	152	294	553	88
Retail trade eating places	1,335	2,714	6,804	151
Drinking places	279	548	1,966	259
Finance, insurance, and real estate	216	395	1,693	329
Services	581	2,327	4,486	93
Hotels and other lodging places	131	361	1,017	182
Health services	63	80	1,073	1,341

[a]Missing data withheld to avoid disclosure of employment data for some individual establishments.

Santa Rosa County

Although Santa Rosa County is located between Okaloosa and Escambia Counties, its employment pattern is different than either of the other two. It does receive some employment spillover from these two counties, primarily in Milton and Pace.

Santa Rosa County does not have a major military base or large number of government employees, and little of its land fronts the sea. Most of Santa Rosa Island, a barrier island, is part of the Gulf Islands National Seashore.

A major portion of the recreational development in the county is located along the coastal area near Navarre, whereas most of the manufacturing is around Milton at the headwaters of Blackwater Bay. Employment in manufacturing probably increased in 1965-78, although precise data for 1978 are not available. Employment in other major categories increased sharply (Table 17). In 1956-65, the greatest increases in number of employees were in construction, manufacturing, and retail trade.

Table 17. Numbers of non-agricultural employees in Santa Rosa County in 1956, 1965 and 1978 (Thompson et al. 1980).

Type of employment	Employment[a] 1956	1965	1978
Mining	---	---	375
Construction	199	526	1,036
Manufacturing	316	1,818	---
Transportation and public utilities	51	173	283
Communication	---	---	61
Wholesale trade	17	120	---
Retail trade	364	697	1,774
Eating and drinking places	(65)	(117)	(370)
Finance, insurance, and real estate	48	174	335
Services	122	230	890
Hotels and other loading places	---	(30)	(72)

[a]Missing data withheld to avoid disclosure of employment data for some individual establishments.

Mining, primarily oil and gas extraction, employed 375 persons in 1978. Most, if not all of these workers were probably employed in the Jay oil fields in the northwestern portion of the county.

Walton County

In 1978, manufacturing and retail trade were the major forms of employment in Walton County (Table 18). Most of the people employed in manufacturing worked in food and kindred industries, and almost 20% were employed in lumber and wood product activities. At a minimum, these two subcategories of employment probably made up at least three-quarters of the work force.

Because most of the shoreline of the county is still relatively undeveloped, most of the county's employment probably is centered around urban areas.

In summary, most of the employment in the more populated counties of Northwest Florida has been in manufacturing, recreation, and the military. In the rural counties, non-agricultural employment is in either paper and allied products industries, or the seafood industry.

Table 18. Numbers of non-agricultural employees in Walton County in 1956, 1965, and 1978 (Thompson et al. 1980).

Type of employment	Employment[a] 1956	1965	1978
Construction	154	178	172
Manufacturing	165	312	778
Food and kindred products	---	---	---
Lumber and wood products	107	---	145
Transportation and public utilities	74	92	137
Wholesale trade	73	47	142
Retail trade	520	486	684
Finance, insurance, and real estate	32	72	87
Services	190	---	285

[a]Missing data withheld to avoid disclosure of employment data for some individual establishments.

TRENDS IN EMPLOYMENT IN MANUFACTURING

In 1970-78, the 7% increase in employment in manufacturing in Northwest Florida was considerably below the State's growth rate of 31% (Table 19). Of the seven counties, only Bay, Okaloosa, and Walton showed sizeable gains in employment in manufacturing. The greatest gain was by Okaloosa County (1,710 employees), and Escambia County (1,407 employees). The gains in Bay County (790) and Walton County (353) were less primarily because of the smaller number of total employees in manufacturing there.

Although Escambia and Bay Counties have the largest number of employees in manufacturing, employment in manufacturing as a percentage of the total employment is at least as high if not higher than the State average of 11% for four of the seven counties (Table 20). Gulf County, for instance, has a particularly large percentage of its employees engaged in manufacturing. In addition, in five of the counties, personal income generated by manufacturing as a percentage of total personal income is equal to or higher than the State average of 13.6%. Gulf County shows the highest percentage among the counties because of the dominance of the paper and pulp industry in Port St. Joe.

Between 1970 and 1978, the number of manufacturing establishments in Northwest Florida increased from 313 to 363 (Table 21). Almost half of this increase was in Okaloosa County. The only other sizeable increase was in Escambia County, whereas the number in Gulf and Walton Counties declined.

Table 19. Number of employees and percentage changes in manufacturing in Northwest Florida and Florida in 1970 and 1978 (U.S. Department of Commerce, Bureau of the Census 1981a).

County	1970	1978	Percent change 1970-78
Bay	2,896	3,686	27
Escambia	12,712	11,305	-11
Franklin	242	182	-25
Gulf	1,287	1,265	- 2
Okaloosa	1,640	3,350	104
Santa Rosa	1,695	1,814	7
Walton	335	688	105
Northwest Florida	20,807	22,290	7
Florida	320,565	419,561	31

Table 20. The percentage of employment and income in manufacturing contributed by each county to the Northwest Florida total (Florida Department of Commerce 1980).

County	Percent of total employment	Percent of total income
Bay	9.1	13.6
Escambia	11.2	17.1
Franklin	8.5	7.8
Gulf	29.3	41.2
Okaloosa	7.0	8.7
Santa Rosa	12.1	19.9
Walton	12.9	13.7
Northwest Florida (% of the total)	11.0	13.6

Table 21. Number of manufacturing establishments in each county in 1970 and 1978 (Florida Department of Commerce 1980).

County	Number of establishments 1970	1978	Numerical change 1970-78
Bay	82	85	3
Escambia	129	145	16
Franklin	19	25	6
Gulf	16	11	-5
Okaloosa	38	61	23
Santa Rosa	14	22	8
Walton	15	14	-1
Northwest Florida	313	363	50

Type of Manufacturing Plants

An inventory of the types of products manufactured in Northwest Florida is basic for determining which establishments may have the greatest potential for supporting OCS oil and gas recovery. The types of products produced in each county by the manufacturing industries and of employment are discussed in the following subsections.

Bay County. In 1979, only one industrial firm in Bay County employed over 500 persons; that was a firm producing linderboard and pulp. The next largest employers were four firms which produced building materials, condensors and packaged boilers, hair barrets and rollers, and oil, fatty acids, rosin, and terpenes.

Several new industries have located and expanded in Bay County in 1977-80. They include manufacturing firms producing products such as industrial cranes and earth-moving equipment, fabricated steel, custom textile products, executive furniture, steel pipe, and other items. With the exception of the new coal conveyor components plant, which located in Lynn Haven in 1978, all new industries are in Panama City.

Escambia County. Major employment in Escambia County is in the manufacture of wood products and chemicals. The nine largest manufacturing firms, in regard to number of employees in 1979, produced fiber ceiling systems, nuclear power reactor parts, nylon yarn and industrial organic chemicals, paper bags and roll print, wrapping, paperboard, paper, chemical materials, newspaper, steel and wood doors, and naval stores, pine oil, and rosin.

In 1977-80 two new manufacturing plants were constructed in Escambia County, and three plants were expanded, all in Pensacola. One of these was an expansion of a paper products company and another was a new chemical plant.

Franklin County. All 14 of the manufacturing firms in Franklin County listed in the *Directory of Florida Industries 1980* (Florida Chamber of Commerce 1980) employed fewer than 50 workers. Almost two-thirds of the employees in manufacturing were engaged in food and kindred products industries (e.g., oyster and shrimp processing and packing). There were no new plants or expansions listed for Franklin County in the period from 1977 to 1980 (Industrial Development Research Council 1977-80).

Gulf County. Four of the eight manufacturing firms in Gulf County employ over 100 workers. In 1979, the largest was the St. Joe Paper Company Paper Mill Division, which had 821 employees. The St. Joe Paper Company also operates a container division in the county. Two of the other major employers produce chemicals and rosin, vegetable oil, and fatty acids. Seventy-five percent of all workers engaged in manufacturing work in industries that are associated with the production of paper and allied products. Most of these industries are located in Port St. Joe. The only new manufacturing plant to locate in Gulf County since 1977 manufactures plywood (Industrial Development Research Council 1977-80).

Okaloosa County. Many of the manufacturing firms in Okaloosa County produce military equipment such as radar, data systems, and security systems, aircraft parts, electronic components, and cargo handling and timing systems. Another relatively large employer (i.e., employing over 250 workers) manufactures lingerie.

Four new manufacturing plants have located in Okaloosa County since 1977: three of these plants are in Fort Walton Beach and the other in Crestview. Three of these four plants manufacture items that are used for recreation.

Santa Rosa County. There are two major manufacturing firms in Santa Rosa County; one produces acrylic fiber and the other lingerie and lounge wear. A third (fairly sizeable) employer produces chemical products. Only one new manufacturing plant located in Santa Rosa County since 1977 (Industrial Development Research Council 1977-80). It produces ceramic-lined pipes.

Walton County. In Walton County, most people are employed in the manufacture of apparel, lumber and wood products, and food and kindred products. DeFuniak Springs is the home of three of the largest employers; a fourth relatively large employer is located in Paxton. Both of these communities are inland.

Two new manufacturing firms have located in Walton County since 1977. A factory producing men's shirts opened in Ponce de Leon and a winery began operations in DeFuniak Springs in 1980 (Industrial Development Research Council 1977-80).

PROBLEMS OF INDUSTRIAL SITING

Future industrial growth in Northwest Florida will depend largely on the availability or capacity of fresh water, sanitary sewers, sewage treatment facilities, electrical power, natural gas, and telephone service, some of which are discussed in the next section. Although raw materials, transportation, market, manpower, and public policy are other factors of industrial development, they will not be discussed in this report.

The criteria proposed by Lochmoeller et al. (1975) that are often used in setting up new industries or expanding old industries are as follows:

> Select only major metropolitan areas which have the expectation of substantial population and economic growth. Be certain that the site is served by either an existing expressway system or one slated for construction. Assess the direction and type of industrial growth near such areas as highway, airports or seaports. Ascertain both community attitudes toward industry and economic pressures in a given area. Determine type of industries which are expanding or which might move into the region. When selecting a specific site it is further important to estimate the amount of land required through a study of local absorption rates. Seek sites which are immediately accessible to major highway routes or have highway frontage; are adjacent to the main line of a railroad; or near an airport or, if appropriate, near a harbor. Watch topography; acquire land with minimum of ledge rock, water, and peat or soft ground. Ascertain that water, gas, electricity, telephone and, if possible, sewers should serve the site, at competitive rates with appropriate capacity.

Based on these criteria, much of the future industrial development probably will locate in or near Pensacola in Escambia County, Panama City in Bay County, and Fort Walton Beach in Okaloosa County. It is unlikely that other cities will have much industrial development, except Milton in Santa Rosa County, which may be affected by development in nearby Pensacola.

One of the problems of industrial development is locating potential sites in floodplains. "Historically, industrial development followed the course of railroads along the river valleys. Because most of these rail lines are being used, and interest in the availability of multi-modal transportation is increasing, flood plains are attractive to industrial development" (Lochmoeller et al. 1975). The problem in Northwest Florida is the double threat of hurricane surge and riverine flooding. Although riverine flooding in Northwest Florida is not considered a major problem except in the Apalachicola River Basin, hurricane surge or tidal flooding (caused by hurricanes and storms) frequently causes severe damage to coastal flood plains. Hurricane surge heights have reached about 4.2 meters (14 feet) in Northwest Florida. Pensacola, Panama City, Fort Walton Beach, and Milton have suffered severe damage from windblown tidal surges. Because of the present trend of development in and around floodplains, there is an acute need for systematic floodplain management programs (U.S. Army Corps of Engineers 1980a).

Another problem concerns the location of industrial development. Coastal Florida is a mixture of beaches, dunes, wetlands, and higher ground. Much of the land that is best suited for development is low and subject to tidal surges; therefore land uses should be carefully planned. Competition for suitable land for industrial and other types of land use is acute, which sometimes leads to improper land use, e.g., the development of cheaper lowlands that are more vulnerable to winds and water surges.

Other factors also affect the selection of industrial sites. For example, the growth of Fort Walton Beach and southeastern Walton County may be limited by the scarcity of fresh water. The Corps of Engineers has reported that cones of depression in the aquifer have formed "as a result of extensive pumping for public supply and irrigation" (U.S. Army Corps of Engineers 1980a). Continued pumping, and particularly increased pumping to keep pace with new development, potentially could result in "the eventual appearance of saline water in the centers of the cones of depression" (U.S. Army Corps of Engineers 1980a). So far this has not happened and is not likely to happen in the foreseeable future.

PROJECTED INDUSTRIAL TRENDS

A report, Industrial, Irrigation and Other Water Needs, prepared for the U.S. Army Corps of Engineers by the U.S. Geological Survey (1979), contains projections of employment at the two digit level of the Standard Industrial Code (SIC) through the year 2030. The projections were prepared for the U.S. Geological Survey by the Bureau of Economic Analysis, U.S. Department of Commerce, and are included as an attachment to the above named report. These projections are shown in Table 22.

The base year used in the projections was 1976; however, in the case of some of the counties in Northwest Florida, some of the projections may have to be revised because employment in manufacturing already appears to be higher than expected. This can be seen by comparing the projections with the 1978 employment data for manufacturing shown in Tables 12-18. Escambia County (Table 13) is a case in point. In 1978, 11,636 were employed in manufacturing whereas the projection indicated that that number would not be reached until the year 2000; consequently the projection for Escambia County must be revised upward. Much the same applies to Okaloosa and Franklin Counties. The population projections for Bay County were overestimated, but the projections for the remaining counties appear to be reasonably accurate.

ONSHORE IMPACTS OF POTENTIAL OIL AND GAS ACTIVITIES

A major development of oil and gas production on the Outer Continental Shelf (OCS) near Northwest Florida would have a major effect on onshore industrial development. Phosphate mining in the waters of the Gulf of Mexico also may have some potential. During the beginning stages of extensive OCS oil and gas development, if it were to occur, there would be competition for existing residential construction to meet the housing needs of OCS-related workers. In addition, it is likely that some of the manufacturing industries that exist in the area would redirect their production to meet the needs of offshore and onshore activities, and that new industries would develop. These new developments would cause considerable strain on community infrastructures and other public services. It is also likely that there would be major impacts on the natural environment. A report on development, issued by the Governor's Office of Planning and Budgeting, has recognized "that potential environmental hazards of onshore development are greater than those of offshore development" and former Florida Attorney General Robert Shevin once recommended that "before offshore oil drilling was approved, tough restrictions be placed of onshore development" (Hoedecker 1980).

Table 22. Projected numbers of employees in major manufacturing industries based on 1976 data for 1990, 2000, and 2030 (U.S. Department of Commerce, Bureau of Economic Analysis 1979).

County and product/industry	Employees[a]			
	1976	1990	2000	2030
Bay				
Food products		150	150	125
Clothing		300	300	300
Lumber and wood products		550	550	575
Paper products		1,025	1,025	950
Printing industry		225	250	300
Chemical products		350	400	525
Rubber and plastic products		175	200	225
Stone, clay and glass products		350	350	300
Fabricated metals industries		225	250	275
Machinery, excl. electrical		600	675	750
Miscellaneous		300	325	350
All others		150	175	175
Total	3,748	4,400	4,650	4,850
Escambia				
Food products		675	675	650
Lumber and wood products		550	550	550
Paper products		1,775	1,700	1,600
Printing industry		700	775	900
Chemical products		5,775	5,875	6,200
Stone, clay and glass products		900	875	825
Fabricated metals industries		650	625	600
Machinery, excl. electrical		175	200	225
All others		350	350	350
Total	11,214	11,550	11,625	11,900
Franklin				
Food products		175	200	200
All others		50	50	50
Total	159	225	250	250
Okaloosa				
Apparel manufactures		400	450	450
Lumber and wood products		200	200	200

(continued)

Table 22. (Concluded).

County and product/industry	Employees[a] 1976	1990	2000	2030
Okaloosa (continued)				
Printing industry		150	175	225
Stone, clay and glass products		50	50	50
Machinery excl. electrical		100	125	125
Electrical machinery		700	750	825
Transportation equipment		225	225	250
All Others		175	175	200
Total others	1,673	2,000	2,150	2,325
Santa Rosa				
Food products		25	25	25
Apparel manufacturers		725	800	800
Paper products		25	25	25
Chemical products		800	825	875
Stone, clay and glass products		150	175	200
All others		100	100	100
Total	1,658	1,825	1,950	2,025

[a]Numbers rounded to nearest 25.

Not all areas of the seven counties of Northwest Florida would be subject to OCS onshore related impacts. Inland communities probably would be little affected. In addition, coastal communities without harbor channel depths of about 5.4 to 7.5 meters (18 to 25 feet) and without adequate dock space would probably be of little service to the OCS oil and gas industry (Calder 1978). The only ports with adequate channel depths are Pensacola Harbor, Panama City Harbor, Port St. Joe, and Carrabelle Harbor. Pensacola and Panama City are the most probable sites. Neither Carrabelle or Franklin County has the residential or manufacturing base needed to support OCS oil and gas onshore needs. Port St. Joe and Gulf County, despite having relatively adequate port facilities and a somewhat greater population and manufacturing base, probably do not have adequate housing, types of supporting industries, and community infrastructure to meet the immediate onshore needs of extensive offshore development.

In general, "offshore petroleum and natural gas production can be abstracted into four of five phases" (Calder 1978). These phases are preliminary geophysical and geological surveys, exploratory drilling, systems development, production, and ultimately, decline (Calder 1978).

During the first phase, onshore support facilities are usually already adequate or are not needed, and there is little impact. It is during the exploratory drilling phase that dock space and harbor depth become issues. The important impacts on a community during this second phase are economic, e.g., suppliers of drilling-related equipment will locate in the area and subsidiary businesses will spring up. OCS oil and gas companies sometimes choose to locate onshore facilities in smaller communities (such as Port St. Joe) because of excessive land values and other negative factors characteristic of urban areas (Calder 1978).

The development of production rigs and pipelines (phase 3) on a large scale in the Northwest Florida area would create new economic and social stresses. This extraordinary labor intensive period would place housing in great demand. Sudden population growth, with its associated industries, causes excessive stress on land use, transportation, and infrastructure and services (e.g., schools and hospitals). In addition, environmental damage could be serious (Calder 1978).

Once the development phase is completed and the production phase begins, construction workers usually begin to leave the area. From a local government perspective, this is a period of post-construction readjustment. This final phase is not as labor intensive as the development phase; therefore, during the development phase, infrastructure and public service expenditures must not be over-committed because they may eventually have to be supported by a reduced population (Calder 1978). To mitigate this, a community could utilize planning procedures to minimize the negative socioeconomic-environmental impacts in much the same manner as the following procedures that were suggested by Myhra (1980) for nuclear power plant construction site communities:

> Recognize that socioeconomic problems may occur and be willing to do whatever it takes to hold them to a minimum. Create an impact mitigation task force, group or team. Develop an impact management plan. Inventory existing socioeconomic conditions at the site area. Determine the estimated influx of new workers and their dependents. Forecast the likely socioeconomic changes on the community. Translate those adverse impacts into net fiscal deficits. Provide appropriate funding and finance to mitigate the impacts. Monitor how well the impact management program is working out. Redirect the allocation of impact assistance where needed the most. Continue readjustment activities as long as necessary after construction is complete.

Implementing a procedure such as the one described above would enable a community to strengthen what is considered "one of the weakest links in the energy facility construction chain" (Calder 1978). This would allow a community to mitigate many of the negative characteristics of "boom-town" development and take full advantage of the positive features that such growth can bring.

DATA GAPS

The greatest data gap in this study of industrial development in Northwest Florida is 1980 data that are needed to provide a relatively up-to-date picture of non-agricultural employment characteristics, especially for places like Bay County, which has added a number of new manufacturing plants since 1978 (the year of the most recent available data). When the 1980 data are available, the study should be updated to verify the interpretation of trends and to make comparisons with other 1980 census information. A new set of projected trends for the counties will have to be developed after the 1980 data become available.

PUBLIC UTILITIES

Population growth and industrial development are partially dependent on the availability and capacity of public utilities. Because OCS oil and gas recovery would place additional demands on public utilities, it is particularly important to understand the type, distribution, and magnitude of services available in Northwest Florida.

INVENTORY OF UTILITIES

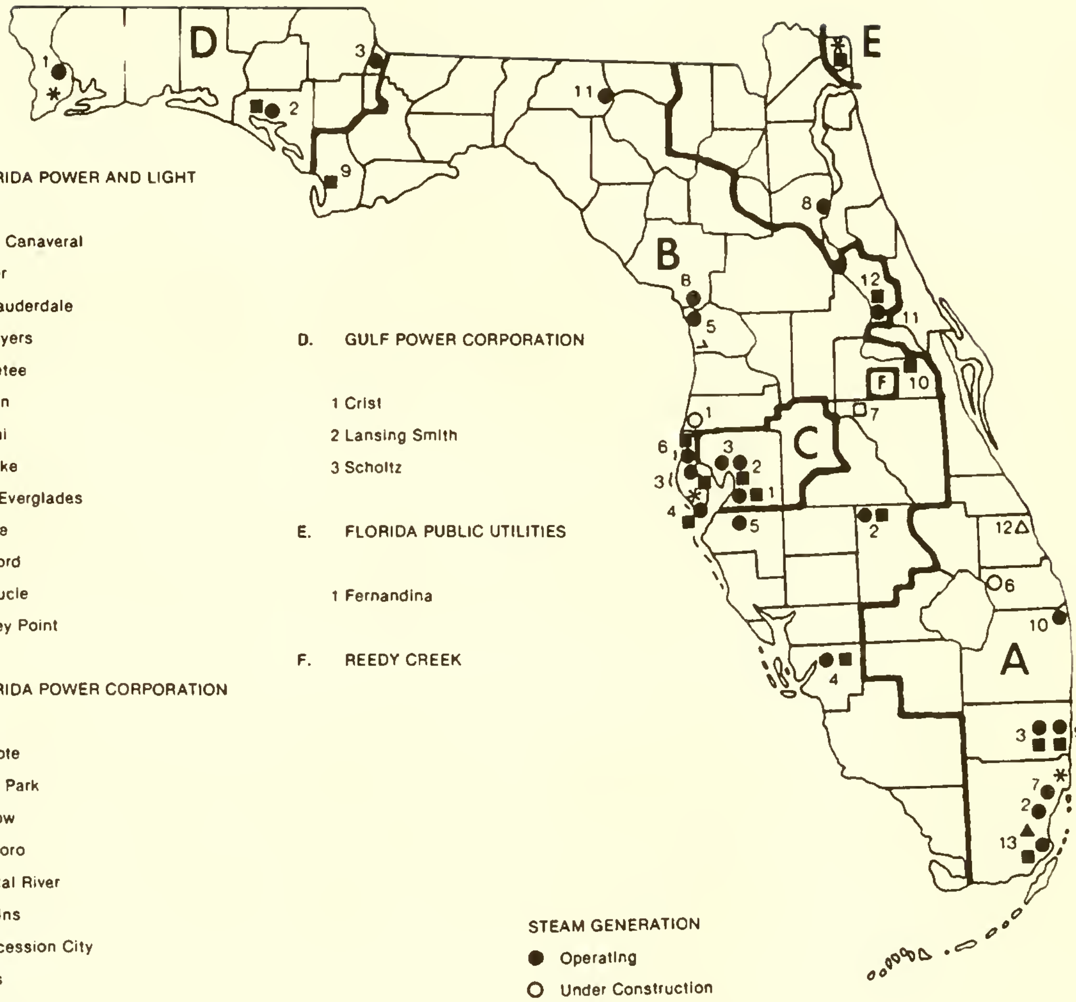
This section briefly reviews the status of electrical power, gas, and telephone services.

Electrical Power

Electricity is provided to users in Florida from a variety of sources through a complex interchangeable grid of distribution. The different sources and ownerships are shown in Figure 6. The service areas of the two privately owned utility companies serving the seven county region are also shown. The Gulf Power Company serves Bay, Escambia, Okaloosa, Santa Rosa, and Walton Counties, plus a few counties outside of the region. This private utility is headquartered in Pensacola. It operates a hydroelectric steam generation plant and an internal combustion or gas turbine plant in Bay County.

Franklin and Gulf Counties are served by the Florida Power Corporation. This power company serves a large area of northwest and central Florida, stretching from Franklin County to Highlands County (in south-central Florida). Company headquarters are in St. Petersburg. It operates many plants within its service area, but the only one in Northwest Florida is an internal combusion or gas turbine plant in Franklin County.

There are no publicly owned power companies in the seven county region, but there are five rural electric cooperatives (Figure 7). One is the Alabama Electric Cooperative, Inc., Andalusia, AL, that serves only a small portion of northwestern Okaloosa County. A second is the Escambia River Electric Cooperative, Inc., located in Wewahitcha. Its service area extends over Bay County, part of Gulf County, and parts of a few other counties outside the region. Talquin Electric Cooperative, Inc., which is headquartered in Quincy (near Tallahassee), serves part of Gulf County, all of Franklin County, and four other counties outside the region. All of these cooperatives are nongenerating.



A. FLORIDA POWER AND LIGHT

1 Cape Canaveral
2 Cutler
3 Ft. Lauderdale
4 Ft. Myers
5 Manatee
6 Martin
7 Miami
8 Palatke
9 Port Everglades
10 Rivera
11 Sanford
12 St. Lucie
13 Turkey Point

B. FLORIDA POWER CORPORATION

1 Anclote
2 Avon Park
3 Bartow
4 Bayboro
5 Crystal River
6 Higgins
7 Intercession City
8 Inglis
9 Port St. Joe
10 Rio Pinar
11 Suwannee River
12 Turner

C. TAMPA ELECTRIC COMPANY

1 Big Bend
2 Gannon
3 Hookers Point

D. GULF POWER CORPORATION

1 Crist
2 Lansing Smith
3 Scholtz

E. FLORIDA PUBLIC UTILITIES

1 Fernandina

F. REEDY CREEK

STEAM GENERATION
● Operating
○ Under Construction
NUCLEAR GENERATION
▲ Operating
△ Under Construction
INTERNAL COMBUSTION OR GAS TURBINE
■ Operating
□ Under Construction
* IOU HEADQUARTERS

Figure 6. Privately owned utilities (Florida Public Service Commission 1980).

Figure 7. Rural electric cooperatives (Florida Public Service Commission 1979).

Of the two privately owned utilities serving the seven county region, the Florida Power Corporation is the largest. In 1979, it generated 18.5% of the total megawatt hours (MWh) produced in Florida, wheras the Gulf Power Corporation produced only 7.0%. The Gulf Power Corporation is 90.4% dependent on coal as its source for generating power, but the Florida Power Corporation uses a much broader range of fuel types for power generation (Table 23). Much (42.8%) of its production is generated from residual fuel, 21.9% from coal, 21.7% from nuclear fuels, and lesser amounts from natural gas and distillate fuel. For Florida as a whole, 47.9% is based on fuel oil, 19.5 on coal, 16.4% on nuclear fuel, 16.1% on natural gas, and 0.3% for hydroelectric power (Florida Public Service Commission 1980). The Gulf Power Corporation is highly dependent on the delivery of coal from out-of-state sources.

Table 23. Electrical generation (megawatt hours) by fuel types (percentage composition in parentheses) by privately owned utilities serving Northwest Florida, 1979 (Florida Public Service Commission 1981).

Fuel type	Florida Power Corp.		Gulf Power Corp.	
Coal	3,811,782	(21.9)	6,000,522	(90.4)
Natural gas	1,373,976	(7.9)	627,562	(9.4)
Residual	7,443,897	(42.9)	1,651	(0.1)
Distillate	976,945	(5.6)	2,717	(0.1)
Nuclear	3,775,837	(21.7)	0	(0)
Total	17,382,437	(100.0)	6,632,452	(100.0)
% of State total	18.5		7.0	

The net generation of power for Florida in 1979 was about three times greater than it was in 1965. In addition, the percentage fuel types have changed considerably. The principal factor in this change has been the generation of power from nuclear fuel. There was no generation of power from this fuel source prior to 1972, but it has already climbed to 16.4% of the State's total generated power. Fuel oil is the major fuel type used for generation, but its percentage share of the total generated in the State slipped from 56.2% in 1965 to 45.0% in 1979. Coal has increased slightly over the past year or two and is likely to take an even greater share of the State total in the 1980's. More than twice as much power is generated by gas than it was 15 years ago, but its proportion of the State total has slipped from 25.0% to 16.1%. Hydro power is now an insignificant source of energy in Florida. (Florida Public Service Commission 1980.)

The private utility companies serving Northwest Florida have a different distribution by class of service than do the electric cooperatives serving the area (Table 24). This is to be expected because the cooperatives primarily serve rural areas. Most of the service provided by the cooperatives is residential use. Talquin Electric, probably because it serves the relatively

Table 24. Utility and electrical sales in 1979 to several types of customers in Northwest Florida by class of service in megawatt hours (MWh) in 1979 (Florida Public Service Commission 1981).

	Customers				
Utility	Residential	Commercial	Industrial	Other	Total
Florida Power Corporation	6,927,339	3,646,279	3,215,932	734,861	14,524,411
Gulf Power Corporation	2,225,026	1,269,357	1,552,364	14,396	5,061,143
Escambia River Corporation	58,969	6,027	4,574	6,353	75,923
Gulf Coast Cooperative	57,470	6,872	5,200	1,009	70,551
Talquin Cooperative	223,051	15,816	32,570	13,048	284,485

densely populated area around Tallahassee (which is not in Northwest Florida) provides the greatest percentage of service among the cooperatives to industrial customers. Although the Gulf Power Corporation has a larger percentage of industrial customers (30%) than does the Florida Power Corporation (22.1%), most of the percentages of electricity sales to ultimate customers by class of service are similar. The Florida Power Corporation provides over twice the number of megawatt hours (MWh) to industries because of its greater overall sales volume. Among the cooperatives, Talquin Electric has the greatest volume of sales.

The 1980 Ten-Year Plan for Florida states that 22 new major generating units are planned to begin commercial operation in 1980-89. Of these, two are oil-fired, one nuclear, and 19 are coal-fired; four of these are located out-of-state (Florida Electric Power Coordinating Group 1980). None of these units is specifically designated for location in Northwest Florida, but since a number of these units are to be operated by the Florida Power Corporation, which is the major provider of electrical power to Northwest Florida, ample electric power should be available to most of the region. The history and forecast of net energy in terms of megawatt hours (one MWh = one million kWh) for the Florida Power Corporation and the Gulf Power Corporation is given in Table 25.

Despite expectations that coal-fueled energy in Florida will increase from 19.3% in to 1980 to 46.7% by 1989 (Table 26), residual oil will remain an important source of energy generation. Although its overall percentage of input to net system generation will drop from 49.9% to 35.3%, the quantity of

Table 25. History (1970-79) and forecast (1980-89) of net energy for load-GWH (millions of MWh) in 1970-89[a] (Florida Electric Power Coordinating Group 1980).

Year	Florida Power Corp.	Gulf Power Corp.
1970	9,855	3,764
1971	10,961	4,072
1972	12,678	4,604
1973	14,817	4,978
1974	14,402	4,983
1975	15,237	5,148
1976	16,032	5,475
1977	17,134	5,823
1978	18,133	6,044
1979	18,812	6,030
1980	18,142[b]	6,140
1981	19,266	6,433
1982	20,468	6,634
1983	21,666	6,880
1984	22,867	7,131
1985	23,945	7,398
1986	25,021	7,671
1987	26,007	7,954
1988	26,970	8,265
1989	27,886	8,553

[a]The 1970-79 annual growth rate was 7.4% for the Florida Power Co. and 5.4% for the Gulf Power Corporation. Corresponding percentages in 1980-89 were 4.9 and 3.3.

[b]Excludes Seminole energy.

Table 26. The quantity of fuel used by fuel type and the percentage contribution (in parentheses) in 1980 and projected to 1989 (Florida Electric Power Coordinating Group 1980).

Type	1980		1989	
Oil	78,312 thousand bbl	(49.4)	83,324 thousand bbl	(35.3)
Coal	9,260 thousand tons	(19.3)	30,030 thousand tons	(46.7)
Gas	132,409 thousand MCF	(13.1)	15,011 thousand MCF	(1.0)
Nuclear	196,000 billion BTU	(18.2)	269,000 billion BTU	(16.8)
Other	0	(0.0)	2.5 billion BTU	(0.2)

residual oil will increase from 78 million bbl to 83 million bbl. The average annual growth rate for electrical energy demand is anticipated to be about 4.5% for the next ten years (Florida Electric Power Coordinating Group 1980).

Gas

According to Moody's Public Utility Manual, natural gas is distributed in Northwest Florida to Panama City, Fort Walton Beach, and Pensacola. Panama City in Bay County is served by Gulf Natural Gas Corporation, Inc. This corporation, with its main office in Panama City, also supplies gas to customers in Tampa for propane carburation for motor vehicles. It is a subsidiary of the West Florida Natural Gas Company. The other two communities, Fort Walton Beach and Pensacola, are served by municipally operated utilities. St. Joe Natural Gas Company, Inc. services residences in some parts of the region (Florida Public Service Commission 1981).

The Getty Oil Company applied to the State of Florida to construct a shell foundation and to drill one natural gas exploratory well in East Bay in Santa Rosa County. The hearing officer for the State recommended that the application be approved in early 1981, but despite this, the Governor and Cabinet, meeting as the Board of trustees of the Internal Improvement Trust Fund, denied the application. The issue is currently in litigation. The case does not directly pertain to potential OCS oil and gas activities because the site is in Florida waters. If the permit is ever granted and recoverable deposits of gas and/or oil are discovered, the onshore impacts of this development might indicate similar types of impacts from OCS oil and gas recovery.

Telephone

Six telephone companies provide service to the counties in Northwest Florida. The General Telephone Company of Florida accounts for about 60% of the total telephone service in the State, and has 11 exchanges in parts of Bay, Escambia, and Santa Rosa Counties. The other five companies are considerably smaller, each providing less than 3% of the total service in the State (Florida Public Service Commission 1981).

The largest of these other companies, the Central Telephone Company of Florida (headquartered in Tallahassee), has nine exchanges in parts of Okaloosa and Walton Counties. The St. Joseph Telephone and Telegraph Company, which has nine exchanges in the region, serves parts of Bay, Franklin, and Gulf Counties. in Port St. Joe (Franklin County).

The remaining three companies each operate only two exchanges in the region. One of these companies is a Florida utility, but the other two are based in Alabama. The Continental Telephone Company of South's main office is in the Panhandle community of Bonifay, but in Northwest Florida serves only parts of Walton County. As for the two Alabama companies, the Florida Telephone company serves parts of Okaloosa and Walton Counties, and the Southland Telephone Company services only a small area of Escambia County.

A list of these six telephone companies, the location of their headquarters, the counties they serve in the region, and the location of their exchanges within these counties are given in Table 27.

Table 27. Telephone companies serving Northwest Florida, by county and location of services in 1980 (Florida Public Service Commission 1981).

Telephone Company counties served	Location of service
Central Telephone Company in Florida (Tallahassee)	
Okaloosa County	Baker, Crestview, Destin, Fort Walton Beach, Shalimar, Valparaiso
Walton County	DeFuniak Springs, Freeport, Glendale
Continental Telephone Company of the South (Bonifay)	
Walton County	Santa Rosa Beach, Seagrove Beach
Florala Telephone Company (Florala, Alabama)	
Okaloosa County	Laurel Hill
Walton County	Paxton
St. Joseph Telephone and Telegraph Company (Port St. Joe)	
Bay County	The Beaches, Tyndall, A.F.B.
Franklin County	Alligator Point, Apalachicola, Carrabelle, Eastpoint
Gulf	Port St. Joe, Wewahitcka
Southern Bell Telephone and Telegraph Company (Miami)	
Bay County	Lynn Haven, Panama City, Panama City Beach, Youngstown-Fountain
Escambia County	Cantonment, Pensacola
Santa Rosa County	Gulf Breeze, Jay, Milton, Munson, Pace
Southland Telephone Company (Atmore, Alabama)	
Escambia County	Molino, Walnut Hill

DOMESTIC SEWAGE TREATMENT

Although treatment of domestic and industrial wastes is a concern common to all of Florida, the problem of pollution is not as acute in Northwest Florida as it is in some other parts of the State. The population growth in the urban centers and along the coast will increase the potential for more pollution. According to the Florida Department of Environmental Regulation the amount of domestic wastewater to be treated is directly related to the population of the area served. Each person uses approximately 100 gal/d for

eating, drinking, bathing, and toilet, and as the population increases, so must wastewater and its treatment (Florida Department of Environmental Regulation 1981).

COUNTY INVENTORY

In 1979, there were 3,704 domestic sewage treatment plants in Florida, but only 140 were in the seven counties of Northwest Florida (Florida Department of Environmental Regulation 1981). About 60% of the domestic sewage dischargers were located in Bay and Escambia Counties.

This section of the report discusses the status of sewage discharge for each county and treatment capacity needs through the year 2000. The information in the following county by county analysis was obtained from a computer print out provided by the Florida Department of Environmental Regulation for October 1979.

Bay County

The municipalities of Panama City and Panama City Beach have the largest capacities for treating domestic sewage in Bay County. The Panama City facility has a design flow of 2.00 million gallons per day (mgal/d) and an average daily flow of 1.92 mgal/d. Panama City Beach also has a design flow of 2.00 mgal/d, but it has an average daily flow of only 0.84 mgal/d. The municipality of Lynn Haven has design flow of 0.70 mgal/d and, like Panama City, has an average daily flow very close to its design cpacity (0.71 mgal/d). The remainder of the domestic sources have considerably smaller design capacities and consist mostly of subdivisions, mobile home parks, and schools. There are 45 domestic sources of sewage listed in Bay County, and most of the sewage from these systems flow into North Bay and then into St. Andrews Bay.

Escambia County

The domestic sewage system with the greatest design flow in the entire region is that operated by the City of Penscola at its main sewage treatment plant. It has a design flow of 9.00 mgal/d; however, its average daily flow of 9.92 mgal/d, is clearly overloading. Only two other systems in the county have an average daily flow greater than their design flow. (One of these is operated by the City of Century and the other is a private development called Avondale.) Of the 40 domestic systems in the county, 6 are municipal systems, 13 are county, 19 are private, and 2 are State systems. The six largest domestic wastewater systems are all municipal or county systems, except for the State system at the University of West Florida. Because of the size of the main Pensacola treatment plant, the greatest drainage in the county is outfall from this plant into Pensacola Bay.

Franklin County

Franklin County has nine domestic sewage systems. Four are municipally operated, four are private, and one is at the St. George Island State Park. The largest system, run by the City of Apalachicola, has an average daily flow of 0.05 mgal/d, which is far short of its design capacity of 0.40 mgal/d. The

only source discharging a greater volume (0.14 mgal/d) than its designed flow (0.10 gal/d) is the system operated by the City of Carrabelle. It discharges into St. George Sound.

Gulf County

In 1979, Werwahatchka was the only domestic sewage system listed in Gulf County. It has a design flow of 0.20 mgal/d. This system discharges into the Chipola River. There is no information about a domestic wastewater system for Port St. Joe.

Okaloosa County

The Okaloosa County water and sewerage system has the largest design flow of the 21 domestic wastewater sources in the county. It is designed to handle 3.0 mgal/d, but its average daily flow is only 2.22 mgal/d. The following three treatment plants have an average daily flow that is greater than design flow: Fort Walton Beach's two sewage treatment plants (2.31 mgal/d as opposed to a design flow of 1.70 mgal/d, and 0.25 mgal/d compared to 0.12 mgal/d), and the City of Niceville's system (0.53 mgal/d compared to 0.12 mgal/d). Most of the discharge is into Santa Rosa Sound.

Walton County

All eight of the domestic sewage systems in Walton County are relatively small. The largest system in the county (operated by the municipality of DeFuniak Springs) has a design flow of only 0.48 mgal/d. All the systems are operating below their design flow.

PROJECTED TREATMENT CAPACITY NEEDS

In the near future, Pensacola, Fort Walton Beach, and Panama City are likely to need greater domestic sewage treatment facilities.

In Escambia County, the growth in design capacity for domestic sewage treatment systems is expected to be 9.41 mgal/d in the year 2000 (Table 28). By projecting the historical mean, about 20 new treatment facilities are needed. In Okaloosa County, growth in design capacity is projected to increase by 5.55 mgal/d and 11 new treatment facilities will be needed. The growth in design capacity for Bay County is projected to be 3.99 mgal/d, and up to 28 new facilities will be needed. The number of new facilities is relatively large because, historically, Bay County has operated a considerable number of small systems and unless there is an abrupt change in local policies, this trend is expected to continue.

The other four counties (Franklin, Gulf, Santa Rosa, and Walton) are projected to have relatively little increase in design capacity and few new facilities. Of the four counties, Santa Rosa County will likely have the greatest increased need, and Gulf County the least (Florida Department of Environmental Regulation 1981).

Table 28. The 1980-2000 average annual population growth rate, given as a percentage, and the sewage treatment capcity (mgal/d) needs by county in 2000 (Florida Department of Environmental Regulation 1981).

County	Population growth rate[a] (percentage)	Increase in design capacity mgal/d	Number of new[b] facilities needed
Bay	2.5	4.0	28
Escambia	2.1	9.4	20
Franklin	2.5	0.6	6
Gulf	2.5	0.1	1
Okaloosa	2.1	5.6	11
Santa Rosa	2.1	1.5	8
Walton	2.5	0.6	5

[a]University of Florida, Bureau of Economic and Business Research, Population and Division forecast.

[b]Assumes historical mean for each county.

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SOCIOECONOMIC TRENDS IN AGRICULTURE

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AGRICULTURE IN FLORIDA - AN OVERVIEW

Agriculture in Florida has traditionally been a major source of income and employment. Employment in forest and agricultural production and agricultural support services, such as machinery sales and service, has risen from about 91,646 employees in 1963 to 127,589 in 1978. From 1954 to 1978, real agricultural income (1967 dollars) rose 145% ($769.0 million to $1.9 billion). Farm income includes cash receipts, government payments, non-money income, and other farm income.

The warm climate and abundant rainfall has given Florida farmers an advantage over many other states. The area of Florida is about 37.5 million acres of which 3.1 million acres are rivers, lakes, and other water areas. The land area available for farm, industrial, and urban use is about 34.4 million acres. In 1978, there were 13.4 million acres of farm land and 15.5 million acres of forests. The two together make up about 84% of Florida's land area.

PRODUCTION TRENDS

In 1978 Florida ranked 11th (Table 1) in the Nation in terms of cash receipts ($3.2 billion) from agricultural products (Greene et al. 1980). Cash receipts is income from the sale of agricultural products by the farmer to wholesalers and retailers. Excluding livestock production, Florida in 1978 ranked fifth nationally with total cash receipts of $2.4 billion (Greene et al. 1980). Prior to 1976, Florida's six major agricultural products were (1) oranges, (2) cattle and calves, (3) dairy products, (4) tomatoes, (5) grapefruit, and (6) forest products. After 1975, sugarcane surpassed grapefruit in value of cash receipts. A more precise classification of agricultural products is given in Table 2. Average cach farm receipts for major farm products for Florida are available from the Florida Institute of Food and Agricultural Sciences, University of Florida. Farm products are composed of field crops (vegetables, fruits, and nuts), greenhouse and nursery products, and livestock and forest products. Unless otherwise stated, the term agriculture or forest products does not include commercial forestry.

Cash receipts from farm products grown in Florida have increased substantially since the mid-1950's. Receipts in 1979 were about $3.9 billion in current (1978) dollars or $1.8 billion in real dollars (1967 = 100). The retail value of all agricultural and forest products was about $10.9 billion

in 1979 according to the University of Florida (Economic data for Florida Agriculture 1975-80). Crops are by far the most important farm income, comprising 50.4% ($5.5 billion) of the total retail value. Forest products contributed 27.5% ($3.0 billion) of the total retail value of farm products, livestock products contributed 14.1%, and farm products (e.g., turf, alligators, catfish) contributed 8%. This pattern of product composition has remained relatively unchanged over the last two decades. The retail value of the major farm products are given in Table 3.

Prior to 1970, a large percentage of Florida products such as livestock, grains, and milk has gone to local consumption and Florida has been a net importer of many types of produce. Citrus has long been an export crop for Florida, but in 1975-79 the State began exporting other agricultural products, which have grown steadily and will continue to be an important part of Florida's economic base. Total agricultural exports to foreign countries excluding forest products at the wholesale level were approximately $529 million in current dollars in 1979, up $245.4 million since 1975. Fruit and related products have been the major export product constituting 52.8% ($279.4 million) of 1979 total foreign exports. Citrus and processed citrus products,

Table 1. Cash receipts (millions of dollars) and national ranking in parentheses of Florida's major agricultural products in 1978 (Institute for Food and Agricultural Sciences 1980).

Field crops	Oranges	Cattle and calves	Greenhouse products	Dairy products	Tomatoes	Florida Total
3,239 (11)	2,383 (5)	358 (25)	271 (2)	247 (12)	189 (2)	3,239 (11)

Table 2. Agricultural, livestock, and forest product classification for Florida (Addison 1981).

Vegetables	Field crops	Fruits and nuts	Greenhouse	Livestock	Forest
Tomatoes	Sugar cane	Oranges	Chrysanthemums	Cattle and calves	Pulp wood
Sweetcorn	Corn	Grapefruit	Gladiolus	Dairy	Sawlogs
Potatoes	Soybeans	Temples	Gypsophilia	Swine	Veneer
Peppers	Peanuts	Limes	Statice	Eggs	
Watermelons	Tobacco	Tangerines	Orchids	Poultry	
Cabbage	Cotton	Avocados		Honey	
Snap beans		Pecans		Horses	

Table 3. Retail value of Florida agricultural and forest products (in thousands of current dollars) in 1975 (Institute of Food and Agricultural Sciences 1980).

Product	1975
Crops	
Fruits and nuts	1,985,248
Vegetables	1,327,684
Field crops	1,265,881
Nursery	556,350
Total crops	5,135,163
Livestock	
Meat animals	388,955
Dairy	395,947
Poultry and eggs	270,278
Other	126,198
Total livestock	1,181,378
Other agriculture[a]	851,070
Forest products	1,714,285
Total retail value	8,881,896

[a]Includes government payments, horses, game birds, alligators, catfish, and others.

predominantly frozen orange juice concentrate (FOJC), make up the bulk of interstate and foreign fruit exports. In order of sales, the other foreign farm exports are vegetables ($67.8 million), soybeans and related products ($39.3 million), tobacco ($17.6 million), and feed grains ($16.4 million). A comparison of foreign agricultural exports for Florida and the United States for 1975 and 1979 are given in Table 5. Florida alone accounts for 26.8% of U.S. fruit exports. In 1975-79 the real value of Florida's foreign exports grew 38.1%, whereas U.S. exports grew only 14.0%. Florida is currently exporting about 13.6% of the value of it's total agricultural products to foreign markets, and the amount is steadily growing. Agriculture exports account for 11.8% of Florida's foreign exports.

In 1954-78, production of Florida agricultural products increased substantially. For example, tomato production increased 237%; oranges, 91%; milk, 144%; and cattle and calves, 35%. The percentage changes of the State's major agricultural commodities in 1954-78 are given in Table 5.

Florida's crops and livestock are produced by 35,100 farms and ranches plus a large network of support industries such as transportation, marketing, processing, and supply. Farms and ranches range from traditional small family or individually-owned operations to a few large-scale multimillion dollar corporate farms. According to the 1978 Census of Agriculture, individual or family farms made up 83% of total farms as opposed to 6.3% for corporate farms. This pattern has remained relatively stable over the last decade. Wilcox et al. (1974) concluded that large corporate farms are not displacing the private individual or family farms. They contend that many of the corporate farms are owned and operated by families and individuals and still exhibit the characteristics of family farms.

The "real" cash value of Florida's agriculture refers to trends which have been adjusted for overall inflation in the economy. Production has expanded (Table 6), real prices have fallen, and the real value of production has increased. Although the increase in farm prices did not keep pace with

Table 4. United States and Florida agricultural exports in millions of current dollars for fiscal years 1975 and 1979 (Greene et al. 1980).

Commodity	1975 U.S.	1975 Florida	1979 U.S.	1979 Florida
Livestock products				
Meat animals	381.9	3.2	844.1	9.5
Dairy products	143.0	0.6	116.1	0.4
Poultry and eggs	112.0	2.6	368.1	9.9
Hides and skins	393.3	3.9	1,302.7	14.0
Lard and tallow	400.6	5.2	704.8	9.9
Crops				
Wheat	5,236.8	0.7	4,862.0	0.3
Feedgrains	4,858.3	14.6	7,026.1	16.4
Cotton	1,054.5	0.4	1,900.0	0.7
Cottonseed oil	213.5	0.1	197.5	0.1
Tobacco	897.3	20.3	1,292.2	17.6
Soybeans and products	3,376.0	21.0	7,515.0	39.3
Peanuts and oil	166.2	7.2	284.8	13.2
Vegetables and preparations	533.9	34.8	756.2	67.8
Fruits and preparations	674.6	141.3	1,042.4	279.4
Nuts and preparations	151.6	0.4	327.0	0.9
Other agriculture and fisheries				
Greenhouse and nursery	16.6	1.2	9.2[a]	0.9[a]
Fishery products	319.8	5.0	520.5[a]	14.0[a]
Other	1,632.9	21.1	2,550.6	35.1
Total agriculture and fisheries	20,562.8	283.6	31,619.3	529.4

[a] Figures for 1978.

Table 5. Percentage change of agricultural commodity production from 1954 to 1978 (Florida Crop and Livestock Reporting Service. Annual field and crop summaries 1967-78, and Vegetable summaries, 1954, 1960-80).

Commodity	Percentage decrease	Commodity	Percentage increase
Potatoes	3	Soybeans	2,658
Celery	12	Sugarcane	650
Hogs	16	Peanuts	260
Oats	18	Tomatoes	237
Tobacco	20	Corn (grain and feed)	227
Snap beans	50	Milk	144
Cotton	84	Sweetcorn	141
		Green peppers	109
		Oranges	91

inflation, the expansion in production offset the declining real prices resulting in a rise in the real value of agricultural production. The strong demand for Florida's agricultural products coupled with rising productivity has increased employment in Florida. Although production has increased, the number of farms and farmland has declined. A detailed analysis of this change is reported later in this report. The number of farms from 1954 to 1979 decreased from 57,543 to 35,100 (39%), and the land area in farms declined from 18.1 million acres to 13.4 million acres (26%). These acreages include cropland, pasture, woodland, and other noncultivated land. In 1954-78, the area of cropland increased 32.9%, whereas the area of pasture and woodlands fell 69.4% (Table 7). Acreage in crops has fallen for corn, cotton, eggplant, oats, peanuts, strawberries, tobacco, tomatoes and others, and has increased for celery, sweetcorn, escarole, green peppers, and lettuce. The decline in agricultural land area in Florida can best be explained by considering other factors of production such as capital, labor, fertilizer, and energy. The increased demand for land was brought about primarily by the great increase in population and its attendant needs, which has raised the opportunity cost of holding land. Opportunity cost is value of the best potential rent or revenue foregone by not renting or selling farmland. Because the price of land has risen faster than wages and the cost of capital, farms used less land and more labor and capital. For example, in 1975-79 land and building prices rose 53.6%, machinery prices rose 46.6%, and wages rose 38% (for the trend in these prices see Table 11).

The introduction of new machinery has made the cultivation of large farms more efficient and less costly per acre than smaller farms. Consequently, many small farms are absorbed as the demand for large-scale operations increases. This trend explains why the average acreage per farm steadily increased in 1954-78. Many of the innovations that have contributed to the phenomenal growth in farm production and farming methods have aroused public concern; the increase in the application of chemicals, fertilizers, and pesticides have

Table 6. The number of farms and the area (thousands of acres)[a] of farm lands and use in intermittent years, 1954-78 (U.S. Department of Commerce, Bureau of Census, Census of Agriculture Annual summaries for 1954-79; Florida Crop and Livestock Reporting Service. Annual field and crop summary 1979).

		Area			
Year	Number of farms	Land in farms	Cropland	Pasture and woodland	Other land use
1954	57,543	18,162	3,398	9,853	4,910
1959	45,100	15,237	3,401	7,672	4,164
1964	40,542	15,412	3,581	7,257	4,573
1969	35,586	14,032	3,774	4,817	5,441
1974	32,466	13,199	3,722	4,019	5,459
1978	35,100[b]	13,435	4,519	3,015	5,901

[a]Not fully comparable for all years because of differences in definition of a farm and of cropland used for pasture.
[b]Data for 1979.

caused water pollution in some areas of Florida. This topic will be discussed in detail later in this report.

The increase in farming technology in recent years in the United States has caused a decline in farm employment (Greene et al. 1980). Florida is an exception. Employment in agriculture has increased because many of Florida's crops can not yet be cultivated or cropped mechanically. Any increase in demand for farm products, such as oranges and grapefruit, creates an increase in the demand for labor and other nonmechanical inputs. The exceptions are the animal industries and some field crops that use mechanization as a substitute for labor.

MAJOR AGRICULTURAL PRODUCTS

Citrus and Other Fruits

Citrus fruits, the State's main agricultural product, accounts for over 30 percent of all farm cash receipts (Greene et al. 1980). Florida is the Nation's largest supplier of oranges and is among the world's largest fruit producers. Other fruits are grapefruit, lemons, limes, avocados, mangos, peaches, and berries. When compared to citrus fruits, other fruit crops are relatively small and few are exported. Most citrus fruit is not marketed fresh as are other fruits, but is processed into frozen concentrate. In 1954-78 the cash receipts of citrus crops increased sharply, but total acreage fell. Loss of citrus fruit acreage was due primarily to the conversion of land to phosphate mining and urbanization.

Vegetables

Florida excells in other agricultural products and between October and June is the Nation's leading supplier of many fresh vegetables. Their abundance in order of importance are tomatoes, sweetcorn, celery, potatoes, and peppers. The State is ranked second in the Nation in the production of tomatoes. Florida's unique climate permits the growth of both cool weather and warm weather vegetables at the same time.

The percentage growth in vegetable production has matched the growth in the State's population until recently. This was due largely to the conversion of farm acreage to urbanization and a decline in yield per acre. The implication of this trend is that a greater share of vegetable production is consumed locally and less is exported.

Nursery Products

The newest and fastest growing of Florida's agricultural sectors are nursery and ornamental horticulture products such as gladiolus and foliage. In this regard, Florida ranks second in the Nation. In 1978 estimated cash receipts were about $271.1 million in real dollars (1967 = 100), up nearly 18% since 1974. Florida is the world's leading producer of foliage plants, accounting for over 75% of the U.S. production. Much of Florida's cut foliage is exported to florists in Europe and Canada. Florida is second in production among the states for flowering plants, gladiolus, chrysanthemums, sypeophila, poinsettas, orchids, and other similar plants. Florida is the Nation's sole supplier of some of the 300 varieties of plants in this industry (Greene et al. 1980).

Animal Husbandry

Animal husbandry is another major sector of agriculture. Excluding forestry, it is the most land intensive sector and is the fastest changing agricultural industry. Rising land values have spurred research to increase productivity by using new feeds, nutrients, and animal breeds. The value ($358 million) of Florida's cattle and calf production in 1978 was second only to oranges in the State and was ranked 25th in the Nation. The egg and poultry industry's cash receipts were $184.2 million, and dairy products were $247.3 million. According to the Florida Crop and Livestock Reporting Service, annual dairy summaries (1970-80); poultry summaries (1960-80); livestock summaries (1960-80), Florida imports beef, lamb, pork, milk, and poultry to meet it's needs, but exports eggs.

Forestry

Forests, the major land use in the State, occupy 15.5 million acres, or 45% of the State's land. In 1978, real cash receipts of forest products were about $61.4 million. Real income increased 18% in 1975-78. Over 50% of Florida's forest land is controlled by non-industrial users (noncorporate owners). The bulk of commercial forests and wood processing and manufacturing plants is located in north and west Florida. Forest products have the largest retail markup of any agricultural products, i.e., 2,500% from the tree to the consumer. Sawlogs and pulpwood are the major products from the State's timber industry.

Although this study is concerned largely with the socioeconomic aspects of agriculture, there are other considerations. Many other jobs, businesses, and other sources of income stem from agriculture. Examples are the feed, fertilizer, and machinery industries that support farming and processing industries, transportation, papermills, services and industries, and others that derive their existence from Florida ranchers and farmers. These subjects are discussed in the following section.

AGRICULTURE IN NORTHWEST FLORIDA

The northwest Florida coastal region (referred to as Northwest Florida in this report) consists of seven counties. It has a land area of 5,542 mi^2, which is about 10.2% of the State total. According to the Florida Crop and Livestock Reporting Service (FCLR), Northwest Florida is a major producer of field crops. The FCLR reports data only for counties that are major producers. Data for no more than four northwest coastal region counties were reported for any one crop. Northwest Florida is a major producer of field corn, soybeans, wheat, peanuts, cotton, poultry, and forest products. Forestry accounts for the major share of the land and income, and forestry and agriculture are among the major industries in this area of the State.

In 1978, the farm land area of Northwest Florida was 442,291 acres, only 3.3% of the State total. Data from Franklin County were excluded because of the virtual absence of farming there.

The land of Northwest Florida is gently sloping or flat. The climate, soil, and topography is best for growing field crops. The weather is generally moderate and and air temperatures range from a high of 90°-95°F in June to August to a low of 20°-30°F in January through March (Florida Statistical Abstract 1980). The annual average temperature of the region in 1979 was 66.9°F. The average annual precipitation was 60 inches and the precipitation among the counties ranged from a low of 1 to 2 inches in March and June to 7 to 20 inches in the rainy season (July - September). The combination of precipitation and air temperatures combined with aquodo soil keeps the soil moist and favorable for pasture, range, woodland, and field crops.

Based on 1979 statistics, farm acreage in Northwest Florida is less than 50% of the potential (Florida House of Representatives Committee on Agriculture 1981b). According to the Soil Conservation Service, Florida had 1.4 million acres in prime farmlands. Prime land is the best suited for crop farming. It is generally flat or gently sloping land with good drainage, and subject to little or no erosion. According to the National Agricultural Lands Study, prime farmland is highly productive, yet requires the least amount of energy, fertilizer, and labor to cultivate. Four of the seven Northwest Florida counties have prime farm acreage. These counties, in order of acreage and cash farm receipts in 1979, are Santa Rosa (116,335 acres), Escambia (106,170 acres), Walton (69,113 acres), Okaloosa (30,962 acres), and Gulf (1,777 acres). Combined, they makeup 342,357 acres of prime land. Franklin County contributed a minor portion of prime farmland and farm receipts.

FARM NUMBERS, SIZE, AND VALUE

The trend in agriculture is towards fewer and larger farms. There were about 5,011 farms and ranches in Northwest Florida in 1954, (about 8.7% of the State's agricultural area). Their combined area was 442,491, acres about 3.3% of the total agricultural acreage in Northwest Florida. Forested lands and farmland combined total 3,257,382 acres or 47.8% of Northwest Florida's land area. The number of farms decreased from 5,011 to 1,952 in 1954-74, but increased to 2,026 in 1978 (Table 7). The decline in farms from 1954-78 was 59%. From 1954 to 1978, the area of forested lands declined less then 3%.

The number of farms and farm area (Table 9) declined faster in Northwest Florida than in the State. Northwest Florida accounted for 8.7% of the farms and 3.6% of the farm land in Florida in 1954, but only 5.4% in 1978. All counties reported a decrease in the number of farms and all but Gulf County showed a decrease in farm acreage. The declines can be attributed to a change in the definition of a farm for reporting, economic factors and the loss of prominence of cotton and tobacco, major area crops. Since 1974 the Bureau of the Census has defined a farm as any place with sales of at least $1,000 in agricultural products in the previous year. Prior to 1974, a farm was defined as any place of less than 10 acres or more with sales of at least $50 the previous year, or any place of less than 10 acres with at least $250 sales in the previous year. This change in definition undoubtably causes problems of interpretation of differences, yet the trends seem to be reasonably clear.

The average farm in Northwest Florida is and has been smaller than the average Florida farm (Table 8). Region farms primarily are small family operations which have been handed down for generations. In 1954, the average farm was 132 acres in Northwest Florida and 316 for the State. By 1978, the average acreage in Northwest Florida declined 66% to 218 acres, the State average dropped to 304 acres (3.6%).

For socioeconomic purposes, the composition of annual farm sales or sale receipts is highly useful (Table 9). Although the acreage between the regions and States is widely different, the percentage of farms in the same income categories are remarkably similar.

In the 1954-78, the value of farms (land and buildings) also increased. In current dollars the 1978 value of the Northwest Florida farms was $326.6 million, 21% of the State total. The real value of farms in Northwest Florida (1967 =100) rose about 76% from about 95.0 million in 1969 to 167.3 million in 1978. The value of land is determined, as in most other commodities, by supply and demand. Since the supply of farmland is relatively fixed, the demand for land for urbanization, recreation, phosphate mining, industrialization, and farming are the major contributing factors to land value.

Land to the farmer is a capital asset and a source of annual income. It draws its value from the prospect of cultivation and future sale. The value of a farm is equal to the NPV (net present value) of the future earnings from cultivation. To the nonfarm user, land value is drawn from the development potential, natural beauty, proximity to retail, commercial or service points, and mineral deposits. The value to these users is the net present value of the future earnings from farm and mineral products.

Table 7. The number of farms (average acreage in parentheses) in the seven counties of Northwest Florida in 1954, 1959, 1964, 1974, and 1978 (U.S. Department of Commerce; Bureau of the Census, Census of Agriculture Annual Summaries for 1954-78).

County	1954	1959	1964	1969	1974	1978[a]
Bay	264 (167)	180 (170)	139 (237)	89 (242)	75 (242)	93 (212)
Escambia	1,334 (118)	782 (174)	642 (197)	577 (189)	494 (182)	525 (146)
Franklin	36 (652)	27 (640)	15 (1,207)	8 (493)	6 (45)	---
Gulf	98 (448)	68 (445)	63 (123)	50 (282)	31 (1,931)	42 (1,400)
Okalossa	863 (120)	598 (132)	447 (191)	385 (197)	407 (215)	387 (201)
Santa Rosa	1,202 (101)	846 (131)	624 (160)	587 (183)	527 (181)	491 (197)
Walton	1,214 (137)	755 (166)	741 (166)	526 (279)	412 (187)	488 (256)
Counties combined	5,011 (132)	3,256 (162)	2,671 (183)	2,222 (215)	1,952 (240)	2,026 (218)
State total	57,543 (316)	45,100 (338)	40,542 (380)	35,586 (394)	32,466 (407)	44,165 (304)

[a] Preliminary 1978 Census of Agriculture data.

Table 8. Farm area (acres)[a] in the seven counties of Northwest Florida in 1954, 1959, 1964, 1969, 1974, and 1978. (U.S. Department of Commerce, Bureau of Census, Census of Agriculture Annual Summaries for 1954-78).

County	1954	1959	1964	1969	1974	1978[b]
Bay	44,182	30,635	32,932	21,502	18,155	19,727
Escambia	156,900	136,027	126,707	108,289	89,844	76,791
Franklin	23,484	17,274	18,112	3,943	270	N.D.
Gulf	43,928	30,279	1,760	14,105	59,867	46,366
Okaloosa	103,804	78,762	85,455	75,981	87,422	77,909
Santa Rosa	120,982	110,682	99,147	107,699	95,249	96,713
Walton	166,554	125,292	122,965	146,940	118,241	124,985
Counties combined	659,834	528,951	487,459	478,078	469,048	---
Florida	18,169,377	15,236,521	15,411,181	14,031,998	13,199,365	13,434,730

[a]Data is based on county location of farm headquarters and may include acreage from adjoining counties.
[b]Preliminary 1978 Census of Agriculture.

Table 9. Number of farms and percent (in parentheses) of farm sales in different income categories in Northwest Florida in 1978 (U.S. Department of Commerce 1981).[a]

Area	Number of farms	Range of sales or income				
		$2,500	$2,500-4,999	$5,000-5,999	$10,000-19,999	$20,000 or more
Northwest region	2,026	632 (32)	370 (18)	292 (14)	187 (9)	474 (23)
Florida total	49,165	15,956 (36)	6,262 (14)	5,432 (14)	4,733 (10)	11,782 (25)

[a]Preliminary 1978 Census of Agriculture.

If for any reason the costs are lowered or demand for the product increases, then the net present value increases. Population increases raise the demand for land for both farm and nonfarm use; however, on urban fringes the demand for nonfarm use of the land usually is greater. The farmer would sell his land if the revenue from the sale exceeds the net present value of further cultivation.

The generalized farm production function is Q = f (L, K, T, C, E) where the quantity of output (Q) is a function of the inputs labor (L), capital (K), land (T), chemical and fertilizers (C) and energy (E). There are many combinations of inputs which yield a given level of output. The farmer usually will use the least-cost combination of inputs that yields a given level of output. The farmer also will adjust the combination of inputs as their costs change or as the productivity (technological change) of outputs changes (e.g., more efficient capital).

Relative prices, expressed as index numbers (Table 10) paid by farmers for selected inputs in 1975-79 demonstrates that real land values have increased 53.6% whereas machinery prices have only increased 46.6%, wages have increased 38%, and the cost of fertilizers and chemicals have declined. Total input costs (excluding land value) rose only 37.2% (Greene et al. 1980). This relative increase in the price of land over other inputs accounts for the substitution of these inputs such as labor and machinery for land. These results are consistent with the hypothesis that Florida farmers have substituted labor, capital, and fertilizers for land as the price of land has risen relative to the other input prices. The practice has increased the unit productivity of land.

Table 10. Index number of prices paid by farmers for production items, interest, taxes, and wage rates in the United States for 1075-79 (Green et al. 1980).

Production items	1975	1976	1977	1978	1979
Feed	187	191	186	183	204
Feeder livestock	134	154	158	221	293
Seed	245	241	261	273	286
Fertilizer	217	285	181	180	196
Agricultural chemicals	60	174	157	147	150
Fuels and energy	177	187	202	211	276
Farm and motor supplies	168	164	165	171	189
Autos and trucks	191	212	234	248	273
Tractors and self-propelled machinery	195	217	238	259	289
Other machinery	197	225	246	266	293
Building and fences	206	215	229	248	272
Farm services and cash rent	199	218	235	245	265
Interest	265	303	331	396	501
Taxes	162	176	195	207	221
Farm wage rates	192	210	226	242	265

The growth of income generated by farming compared to the growth in farm land value is another consideration. Many farms are transfered by older family members to young members. The income from production is used to pay off the older family members control of the farm. If the earning power of a farm does not keep pace with the growth of the farm's value over time, it becomes exceedingly more difficult to purchase the farm on a payback basis from farm income. In 1954, the ratio percentage of cash receipts for agricultural products to value of land and buildings was 19.6% in Northwest Florida and 18.0% for all of Florida. In 1978, the percentage of cash receipts was 14.2% and 19.8 respectively.

Agricultural land is disappearing nationwide, in Florida, and the Northwest Florida. It is anticipated that this pattern will continue and the rate of change in land use may even be accelerated as population growth increases the demand for more land.

FARM INCOME, EXPENSES, AND CONSUMER DEMAND

This section explains many of the concepts that are important for analyzing the value of agriculture and forestry in Florida and how they relate to Northwest Florida. Historically farmers have earned less than the average worker, but this breach is being rapidly closed. For example, farm income per person once was 25% less than nonfarm income (Wilcox et al. 1974). Florida's farm income rose steadily in 1954-79 to $4.1 billion. Since 1954, Florida's total personal real income grew 454%, real farm income grew 145%, per capita income grew 145%, but the cost of living increased 170%.

Historically, farmers have, as an economic group, generally earned less than the average American worker, but this breach is rapidly being closed. For example, in 1970, farm income per person was 25% less than nonfarm income (Wilcox et al. 1974). Farm income is based on cash receipts, government payment, nonmoney income, land rental, and farm services.

The American farmer is finding it more and more difficult to make a living at farming. Some are seeking second jobs or receive income from land rental and farm services provided to others. Income from land rental and farm services has helped soften erosion of farm income.

Gross farm income depends on the quantity of output, and farm prices. Farm output has risen, but real prices at the farm level, as opposed to the retail level, have continued to fall, reflecting greater production and profits per acre. Yet any large increase in production brought about by new technology helps lower prices. Farm prices are less stable than farm production costs, and this tends to make net farm income fluctuate greater than gross farm income. The trends in gross and real farm income in 1954-78 are shown in Table 11.

Information on total farm income for Southwest Florida is unavailable. Because cash receipts from marketing farm products contribute a majority of total income, they are, therefore, used as a proxy. In 1974-77, cash receipts from farm products were about $471 million in current dollars in 1978, up nearly 65% since 1974. The real dollar value of the cash receipts has not

risen as rapidly. In 1974-78, real cash receipts have fallen as inflation outpaced earnings. Farmers are better off now than before, but this came about only because the real prices of many farm products have steadily declined.

Government support payments, another component of farm income, steadily increased from a low of 3.2 million current dollars in 1954 to a high of 20.8 million current dollars in 1977. The real value of government payments peaked in 1964 and have steadily declined since. The original intent of these support payments was to stabilize farm income by providing relief from widely fluctuating commodity prices. Although providing a temporary solution, support payments have, in some cases, aggravated the problem in the long run. For some of the State and regional products, support payments are compensation whenever the farmer sells below a standard price. In essence, an artificial price above the natural market price is maintained which induces area farmers and ranchers to increase production, further lowering the market price, and widening the gap between the natural and artificial price. These payments appear to encourage low unit production.

Table 11. Florida farm income (millions of dollars adjusted to 1967 = 100) for intermittent years from 1954 to 1978 (Florida Crop and Livestock Reporting Service. Annual summaries for 1955, 1959, 1960, 1965, 1970, 1975, 1976, 1977, 1978).

Year	Florida		
	Gross farm income	Real gross farm income	Real farm income[a]
1954	618.6	768.4	303.1
1960	853.7	762.5	362.9
1965	1,064.2	1,124.9	380.6
1970	1,387.9	1,201.9	344.4
1975	2,628.0	1,663.8	600.0
1976	2,637.8	1,547.1	506.9
1977	2,785.5	1,543.7	436.3
1978	3,401.0	1,741.4	677.0
Percentage increase			
1954-78	449.7	123.3	123.3

[a]Net income is gross income, minus production, processing, and distribution costs.

Another problem is that the aggregate demand for farm products is highly inelastic (i.e., the percentage change in the quantity demanded is always less than the percentage change in price), yet the demand curve confronting the individual farmer is almost perfectly elastic (i.e., the individual farmer can sell all he wants at a given price). The farmer has little control over the price at which he sells, but may sell all he likes at the market price. This encourages the farmer to increase production because it is the only way income may increase when productions costs are high and prices are low. As each farmer strives to increase profits, market supply of farm products increases and prices fall. Given an inelastic aggregate demand for food, a decline in prices lowers total revenue. In the long run, the farmer is caught in a rather vicious circle. The cobweb theorem states that farmers react differently in the short run than in the long run. During lower prices, farmers tend to plant less acres in the year following price cuts. Some producers take even more drastic steps such as slaughtering livestock and destroying crops to reduce supply and increase prices.

In recent years, the real income of Florida farmers has steadily declined, but retail food prices have increased. The price index of food items prepared by the Survey of Current Business rose 86% in 1959-74, but consumer prices rose only about 70%. Much of the inflation in consumer prices can be attributed to rising U.S. retail food prices. Since 1974, rising energy costs have replaced high food prices as the major contributor to inflation. The real prices of peanuts and corn have remained relatively stable despite rising current prices. Both current and real beef prices rose during this period. In the case of beef, it means that region farmers are receiving more income per acre, Whereas real retail food prices have soared. In short, while the amount of the consumers' income spent on food has risen, the amount received by the farmer has declined.

In view of the price dilemma, farmers should know how consumers react to a change in the price of a commodity or to a change in their income. Price elasticity indicates the percentage change in the quantity demanded by consumers when prices change as little as 1% (Table 12).

Table 12. Price and income elasticities (percentage change) of major food groups (U.S. Department of Agriculture 1981).

Food group	Price	Income
Meat	0.6196	0.1212
Vegetables	0.0933	0.1816
Poultry, fish	0.6591	0.1682
Fruits	0.4134	0.2613
Eggs	0.0679	0.0625

Elasticities are for the demand at the retail level. If the price of these commodities increases 1%, the price elasticities of these products indicate that the quantity consumer demand would fall by 0.6196% for beef, 0.0933% for vegetables, 0.6591% for poultry and fish, 0.4134% for fruits, and 0.0679% for eggs (Table 13).

Should the consumer's real per capita income rise by 1%, then the demand should increase by 0.1212% for meat, 0.1816% for vegetables, 0.1682% for poultry and fish, 0.2613% for fruits, and 0.0625% for eggs. These elasticities, of course, have important implications for retail revenue and pricing strategy.

The effects of income, the trend in real farm product prices, production, and their implication to Southwest Florida and the State are more fully discussed in the following sections. First, they will be discussed as they apply to individual commodities and later as they affect the entire agricultural sector.

Agricultural resource scarcity is tied directly to trends in the real prices of agricultural products. Scarcity can be measured by the trend in real prices of resources according to Barnett and Morse (1963). This trend in real prices measures the interaction of supply and demand.

Agricultural resource scarcity would mean rising real prices at the wholesale level causing a diminishing return from the land. The ultimate burden will be on the consumer if the standard of living declines.

FARM EXPENSES

Real farm expenses currently are growing faster than real farm income. Real total expenses in 1978 for Florida farmers were $1,049 million and are growing at an annual rate of 3.9%, but real farm income is growing 3.2%. The difference is caused by the general decline in real farm prices and the increasing real costs of production.

A decline in prices is preceded by the sale of an additional unit of output (marginal revenue), yet most real costs have been rising. Interest prices rose 89% in 1975-79 followed by increases in energy prices (55%), farm machinery (46.5%), and farm wages (38%). Fertilizers and agricultural chemical costs have fallen 9.6% and 6.2%, respectively.

Pesticides, Fertilizers and Agricultural Chemicals

The costs of agricultural chemicals, fertilizers, and pesticides generally declined in 1975 to 1979, but since then costs have begun to rise. Only the price of limestone has remained stable. In 1978 in Northwest Florida, farmers spent $12 million real dollars on fertilizer, an increase of 30% since 1954, whereas the State reported an increase of 41%. In 1978, farmers also spent $8.4 million in real dollars on other agricultural chemicals.

Vehicles, Machinery and Energy

In 1975-79, the real cost of vehicles, trucks, cars, tractors, and farm implements increased. Even though the real price of tractors rose about 50%, farmers have increased their use of tractors and other implements. The number of tractors increased by 46% and trucks by 26%. Farmers have increased the use of these inputs because they have substituted them for labor or land. As machinery has become more efficient, it has allowed the farmer to lower his use of land and labor, and because it is more productive, its cost per unit of output is declining.

Real fuel and energy prices also have increased substantially. The current price paid for diesel fuel rose from 10.2 cents per liter in 1975 to 25.3 cents per litter in 1979. In real prices, this was an increase from 6.9 cents to 8.6 cents per liter. Gasoline price increases were similar to that for diesel fuel.

Wages

The wages of farm labor in 1975-79 increased about 38%. When this is broken down into categories, "piece rate" workers received the largest increase (45%). Farmers have not decreased the use of labor overall because the high value of land has lead them to substitute labor and capital for land in the production of agricultural products.

To increase profits, most farmers will continue to adjust their use of inputs as their relative prices change up to the point of technical feasibility. Farmers also will continue to increase input until the cost of an additional unit of input equals the revenue from the sale of an additional unit of output. Most farmers will increase the use of fertilizers as long as the cost is less than the additional revenue.

AGRICULTURAL COMMODITIES

Northwest Florida accounts for little more than 2% of the State's total cash receipts from farm products, but it accounts for a substantial portion (14.6%) of the State's timber sales. Crops (i.e., vegetables, fruits and field crops) accounted for 49.5% of Northwest Florida's total agricultural and forest sales in 1978 and 1.4% of the State's total crop sales. Livestock and poultry products accounted for 35.4% of the region's total agricultural and forest sales, and 2.6% of the State's livestock sales. Timber accounted for 13.9% of the region's sales and 14.6%of the State's timber sales. Northwest Florida is a major producer of soybeans, poultry and field crops such as peanuts, wheat, corn, and cotton. Santa Rosa County alone produced 84% (3,197 bales) of the State's cotton crop. The counties ranked in order of the value of production are Walton, Santa Rosa, Escambia, Okaloosa, Gulf, and Bay. There are no data for Franlkin County. The value of the primary agriculture and forestry products for the region are given in Table 13. The following section is a detailed discussion of Northwest Florida farm commodities.

Table 13. Northwest Florida's five major agricultural commodities and major producing counties in 1978 (U.S. Department of Commerce, Bureau of the Census 1978; Florida Crop and Livestock Reporting Service 1978).

Commodity	Cash value ($ millions)	Percent of Northwest Florida production	Percent of State Total	Major producing county
Soybeans	21.0	32.9	30.1	Santa Rosa
Timber	8.9	13.9	14.6	Bay
Broilers	6.7	10.5	8.2	Walton
Corn	5.9	9.2	14.6	Santa Rosa
Beef	5.7	8.8	1.8	Okaloosa
Peanuts	5.7	8.8	14.5	Santa Rosa
Other[a]	9.9	15.9	--	---
Total	63.8	100.0	16.0	

[a]Includes cotton, eggs, hay, hogs, oats, tobacco, and wheat.

SOYBEANS

Soybeans were the major cash farm product in 1978. Production was 108.9 million lb, 251% greater than in 1961. This increase came about primarily because of increased acreage rather than increased productivity. The soybean acreage increased 225% (33,200 acres to 1.1 million acres) from 1961 to 1978. Production per acre in 1961-78 ranged from a high of 28 bu in 1967 to a low of 21 bu in 1972. Major increases in productivity are likely only if strains of disease resistant soybeans are developed and more productive varieties are used. The major soybean producing counties are Santa Rosa, Escambia, and Okaloosa. The soybean crop is used primarily for animal feed and soybean oil and is marketed locally and throughout the State.

The current dollar income rose from $2.63 a bushel in 1954 to $6.80 a bushel in 1978, an increased of 158%. The real price was relatively constant in 1954-78. Farmers could keep up with inflation only by selling more products as the real price of their crop was falling. Changes in consumer income only indirectly affect the demand for soybeans. For the farmer, elastic demands for soybeans increase total revenue as the real price falls. If the percentage change in the quantity demanded is greater than the percentage change in price, total revenue will increase. Most farm commodities face an inelastic demand, but the versatility of soybeans (i.e., the numerous food and non-food uses) creates an eleastic demand.

The demand for soybeans has increased sharply as evidence by a sharp increase in the number of acres planted. A major reason for this demand has been the development of a wide variety of new uses for soybeans. Soybeans are made into synthetic meats, cheese, vegetable oils, and commercial animal food. The use of soybeans also has expanded because the real price of soybeans has remained constant whereas the real price of competitive products has increased.

Timber

Northwest Florida accounted for 14.6% of the State timber harvested in 1979 and 9.7% of its value. In 1969-79, the total volume of forest saw timber for Northwest Florida increased 85.9% (4.5 billion to 6.3 billion board ft). During this period, total commercial forest land (2.9 million acres) in the region decreased about 3%. The real cash value of the timber harvest in 1978 was $4.6 million. The largest producer was Bay County, which contributed 23.6% of the production.

Northwest Florida supports a multitude of forest product and marine industries such as the large pulp and paper industries (St. Joe Paper Co. in Gulf County and Southwest Forest Industries in Bay County) and numerous loggers, cabinet makers, lumber stores, and saw mills. In 1978, the real income of forest products was $206 million, about 18.5% of the State's forest products income. These industries use timber for paper, pulp, lumber, chemicals, and a host of other wood products. Increased income has come about by using bark and wood shavings as a fuel.

Competition for other land uses has led to a reduction in commercial forest land. In 1969-79, the area of commercial forests in Northwest Florida

decreased by 3%, which was less than that for the State. The smaller loss was because of private ownership composition. About 41% of the forest land is owned by private forest industries, and their holdings were relatively stable in 1969-79. The area of Municipal, State, and Federal forested lands have increased about 3.3%, but it is farm woodlots that has decreased in area (357,000 acres in 1969 to 135,000 acres in 1979). Farmers have tended to hold forest land as a reserve against unforseen cash needs, but have sold off these lands to raise income when inflation outpaced farmers earnings or, when feasible, they converted forest lands to pasture or cropland. In a 1973 publication the Florida Division of Forestry reported that about 45% of the farmers in Northwest Florida were willing to sell forested lands. Owners further south are less willing to sell.

Because the real price of timber in Northwest Florida has been rising, an apparent scarcity exists (Barnett and Morse 1963).

Poultry

Based on cash receipts, poultry (principally broilers) rank first in importance among animal products in Northwest Florida and third as an agricultural commodity. The 1979 dollar value of broilers in 1978 was $6,741,000 ($3.5 million in real dollars). Of the seven counties in Northwest Florida, Okaloosa, Santa Rosa, and Walton are major poultry producers. Although Santa Rosa County is a major producer, data were not made available to avoid disclosure of individual operations. In 1978, Okaloosa and Walton Counties sold 5.3 million broilers; 8.2% of the State's broiler sales. Broiler sales in Northwest Florida increased 72% in 1974-78, but State sales increased only 36%. Broilers in the cash receipts for Okaloosa, and Walton counties was $8.4 million 1978.

The real price of broilers received by farmers decreased from 30 cents a pound in 1954 to 14 cents a pound in 1978. Given that the price elasticity of poultry at the retail level is 0.5910 (U.S.D.A. unpublished data), and the real price of poultry has risen at the retail level, retailers have increased total revenue. When the price of poultry rises by 1% at the retail level, consumer demand will fall 0.591%. Since total revenue equals price times quantity, the retailers total revenue will rise. The implications for the farmer are quite the reverse. As the real price of poultry falls at the farm gate by 1%, wholesalers and retailers will increase the quantity demand by less than 1%. This means that total revenue should fall. This, of course, has not been the case because of growing consumer income, population growth, and the rise in other meat prices have greatly increased the demand for poultry. The income elasticity of poultry is 0.2103 (U.S.D.A. unpublished data).

Poultry are not scarce according to Barnett and Morse (1963), because the real price of poultry at the farm gate has been declining, and the supply is growing faster than demand.

Corn

Corn is grown on more acreage in the State than any other crop. The two basic types of corn grown in Florida are sweetcorn for human consumption, grown primarily in central and south Florida, and field corn for animal feed, grown primarily in west and north Florida. The bulk of the corn is now sold

at harvest time to livestock and poultry producers. Previously, field corn was produced largely for consumption on the farm. Corn has recently become a valuable cash crop in Northwest Florida. Cash receipts were $5.9 million in 1978 or $3.0 million in real dollars (1967 = 100), an increase of about 115% from 1960 to 1978. According to the Florida Crop and Livestock Reporting Service, Field and Crop Summary (1978), Northwest Florida produced about 98.6 million bu of field corn in 1978, about 14.6% of the State's production. Corn production among counties in order of volume are Santa Rosa, Escambia, Okaloosa, Walton, and Bay. Northwest Florida farmers increased production by 138% in 1960-78 yet the total land planted increased only 16%. Increased productivity was caused largely by better fertilizer practices, irrigation, new earlier maturing hybirds, and the use of insecticides.

The real cost of producing an acre of corn in Northwest Florida declined 2.8% in 1975-78. Although real costs for equipment, insecticides, and herbicides rose sharply (up to 176%), the real cost of seeds and fertilizers declined. Considering that the real price of corn has not fallen and real costs have, farmers now are better off than before. This advantage is even further amplified considering that the cost of producing an acre of corn has fallen, but the yield per acre has risen. The average yield per acre in Northwest Florida was 2,000 lb whereas the State average was 1,577 lb.

The real price of corn remained fairly stable from 1954 to 1978 because the demand for corn was partly derived from the demand of other products that use corn as part of the input. Field corn is largely used as livestock and poultry feed. The demand for corn is not only a function of its price but also the price of other feeds, and the demand for beef, poultry, and pork. Like most other feed grains and agricultural products, the demand for corn is inelastic with respect to price. If the price of corn falls by 1% the demand for corn will increase by less than 1%. The real price of corn has remained stable indicating that demand and supply are growing at about the same rate. The increase in demand for corn is attributed to a rise in consumer income (inducing consumers to purchase more beef) and a rise in population. This stable price indicates an abundance of corn according to the assumptions of the Barnett-Morse scarcity hypothesis.

Cattle and Calves

In cash value, the cattle industry in Florida in 1978 ranked second to oranges and fifth among the counties of Northwest Florida ($5.7 million in 1978, or 2.9 million in real dollars; 1967 = 100). The 1978 regional count was 17,805 beef cattle, about 1.5% of the State total. This count is conservative because Bay and Gulf County figures were excluded to avoid disclosure of individual forms. Northwest Florida probably produces about 1.75% of the State's beef cattle. Okaloosa County currently is the major producer of beef cattle. Annual production increased slightly in 1954-78, but began to decline recently because land values were rising.

The real value of cattle and calves received by farmers rose in 1954-79 from $6.00 a lb in 1955 to $10 a lb in 1978, which suggests a scarcity of supply. The total revenue has increased because the percentage change in demand is less than the percentage change in price. Real prices at the retail level increased less than 1% annually in 1954-78. This rise in prices was caused by a demand that grew faster than supply. The growth in demand

relative to supply caused the upward trend in real prices. At the retail level, the price elasticity of beef is 0.679% (U.S.D.A. unpublished data).

The income elasticity of beef is 0.2655 (U.S.D.A. unpublished data) so that a 1% increase in real consumer income results in an increase in consumer demand by 0.2655%. This increase in demand coupled with the rise in population has offset the effects of price elasticity on demand and total demand has risen.

Other Agricultural Products

Northwest Florida is a major producer of many of the State's other field crops and in one instance, practically the sole source. In 1978, peanuts ranked sixth in cash value and had a current dollar sales of about $5,640,000 ($2,887,864 in real dollars; 1967 = 100). Total production in 1978 was about 264,000 lb, or 14.5% of the State's production. Santa Rosa County is the major producer in Northwest Florida and the State's second largest producer. Production has increased primarily because of an increase in productivity. For example, the increase in yield per acre rose from about 1,300 lb in 1961 to 3,400 lb in 1978. In 1954-78, the real price of peanuts has remained relatively stable because of a sufficient supply of peanuts.

Wheat is another important crop in Northwest Florida. Sales of $1.1 million in current 1978 dollars were about 54% of the State's total production. Output declined 18.5% in 1961-78, and acreage declined 26%, which indicates that the yield per acre has been increasing. The real price of wheat has been relatively constant since 1954; apparently there is no scarcity of supply. The decline in acres of wheat and cotton is attributed to an increased in the value of soybeans as a cash crop.

Cotton is produced primarily in Santa Rosa County. In 1978 Santa Rosa's production of 3,197 bales of cotton accounted for 84% of the State's production. Since 1961, total acreage has declined 55% and production fell 70%.

Other agricultural commodities include milk, oats, hogs, and hay. Detailed information on these crops is not available because they are relatively unimportant.

AGRICULTURAL PROBLEMS AND POLICIES

Major problems in Northwest Florida are conflicts among land use, water use, environmental protection, rising energy demands and costs, and competition for markets.

LAND USE

Most apparent to Florida's farmers is the "disappearance" of agricultural lands. The Florida House of Representative's Committee on Agriculture has prepared a report on this issue entitled "Agricultural Lands in Florida" (1981a). That report begins with the observation that Florida's agricultural (1981b) lands are slowly being converted to other land uses. Agricultural

land is used for new homes, schools, shopping centers, airports, industrial parks, recreational areas, and other uses associated with a growing urban population and phosphate mining. The report contends that Florida, as one of the fastest growing states, will continue to put an inordinate demand for "new" lands. Some of the loss of prime and unique farmlands is irreplaceable, a focal point of the Committee's argument for the retention of agricultural land. To combat this loss, the Committee recommended more comprehensive land use plans, extensive soil surveys and mapping, elimination of any State projects that might have a serious adverse impact on farm lands, and the monitoring of local land use alteration or development.

The Committee's report does not identify the economic reasons why the trend in agricultural land loss is necessarily unwanted, unproductive, or socially unacceptable. Recently there has been much discussion and concern over the disappearance of farm land because of its impact on future generations, and the capacity of the remaining land to sustain the population.

The change of agricultural lands to other uses is the natural response of any freely functioning market. So far, agricultural production is rising faster than the land is disappearing. In 1954-78, the area of agricultural lands in Florida declined 26% whereas agricultural production increased 146%.

When the market system is functioning normally, the price operates as a signal. The rise in land values signals the farmers to lower their costs by using less expensive capital and labor. This shift allows resources to be utilized by those who value them the most and permit a more efficient allocation of resources. Efficiency increases because it forces the farmers to use least-cost methods of production and become more productive with the resources at hand.

There is yet another viewpoint on the changing pattern of land use. Perhaps it is not the demand of nonfarm land users that is responsible for the loss of agricultural lands. Improved technology has increased productivity per acre and decreased the agricultural sector's need for land. Farmers find that they can produce more with less land, and cut expenses and raise revenue by selling land. In short, the farmer is releasing land for other uses. Generally, urban populations cannot increase without the use of additional land.

ENVIRONMENTAL CONFLICTS

Florida is no longer a frontier land where the conflict among industry, agriculture, cities, and citizens were not major environmental issues. Only a few decades ago pollution was at low levels and chemicals were natural, biodegradable, and deteriorated in a short time or turned to sediment. Land, timber, water, and other resources were abundant. After intensive land development, these land uses often are in serious conflict. Examples are the emissions from a fossil-fueled power plant that may indirectly damage forests, crops, lakes, and even buildings because of acid rain. Chemicals and pesticides often are used without much restriction. These are often made of synthetic compounds which take many years to break down and complicate nature's capacity to assimilate them. Further conflicts are given in the following sections.

Pesticides and Chemical Fertilizers

To quote Seneca and Tausig (1979):

> In the long-run perspective of history, the development and extensive use of effective pesticides have made a major contribution to human welfare. Pesticides are responsible for enormous increases in agricultural yields and for the control of once widespread and debilitating diseases. Pesticide research findings again reveal the recurring theme of environmental problems, a difficult, benefit-cost type of decision whether, and to what degree, to continue pesticide use and gain protection of crop yields and lower incidences of some human diseases at the cost of considerable long-run damages to environmental conditions and increased risks to human health.

Insecticides not only destroy insects and a wide range of other land animals, but some of the chemicals are carried by runoff into lakes and rivers. Some waters may be so badly polluted that fish and other aquatic organisms may die. Long-term effects are contamination of drinking water and chemical accumulation in the food chain.

Nutrients in runoff from farm lands that are enriched by chemical fertilizers may cause accelerated eutrophication in the receiving waters. The results may be noxious algal growth, excessive aquatic plant growth, and in some cases, oxygen depletion and fish kills. Water hyacinth in Florida is a particularly difficult problem. These floating plants clog waterways and lakes, tie up nutrients, and obliterate underwater photosynthesis. Practical control of these plants is unknown.

Eventually the use of pesticides and chemicals may be reduced without decreasing the yield and quality of farm products. The use of strong, more resistant plant strains, sterile males, insects that feed on pests, enforced diseases, and the use of radiation are means of combating pests and parasites without chemicals or pesticides. Currently, experiments are underway, but new methods of control are not working. The rising price of petrochemicals that produce many of these pesticides and chemicals may make other means of pest control much more attractive in the future.

Animal and Human Wastes

Animal wastes (from feed lots for example) are another major pollution problem confronting farmers. These wastes enter ponds, lakes, and rivers primarily through runoff. Rainfall is abundant in Northwest Florida, and runoff from manure is a major concern in some areas. The solution may be that both animal wastes and urban sewage will be used for feed and fertilizers.

Energy

Energy is a problem, not because there is an energy crisis, but because of the burden imposed on the farmers by the rising cost of fuel. In Northwest Florida, farmers rely on petroleum and petroleum products in all phases of production and marketing. Use of chemicals, pesticides, machinery, tractors, and transportation services will expand as farmers are called upon to increase output. Despite the importance of oil and electricity in farm operations,

consumption by this sector accounts for only 3% of U.S. energy consumption and less than 5% of Florida's energy consumption. In 1978, petroleum made up 75% of all energy used in agriculture. Use of petroleum for energy on Florida's farms increased 35.7% in 1974-78. The energy expended on production, food processing, transportation, wholesale and retail trade, and home storage and processing is only about 12% of the total U.S. energy use (Smerdon 1975).

The challenge of the next decade will be for farmers to increase production as the population increases and to apply even more energy efficient farming methods. Research is underway on solar methods for drying agricultural products, and studies are being conducted on new methods of irrigation which will reduce both water and energy use and even help protect crops from the cold. Such methods would lower the use of outdoor heaters that are now protecting citrus and vegetable crops from winter freezes in Florida. The development of new disease resistant and high yield crops will help lessen energy use. These methods and many others are now being studied to help conserve energy.

Labor

In Florida, labor in the past has been unskilled, relatively cheap, and seasonal. As the trend in increasing farm size and mechanization continues, unemployment patterns also will change. Increased skills and training of farm laborers are now needed for the operation, and maintenance of farm machinery and new cultivation practices (Covey 1975). The need for this skilled labor will bring farmers into direct competition with industry, thereby forcing farmers to raise wages to retain or attract new workers. In addition to raising wages, farmers must increase productivity if they are to maintain profits.

Air Pollution

Agricultural damage from air pollution is difficult to assess. The major effluents responsible for damage to crops and livestock are sulfur dioxide, ozone, and fluorides. In Northwest Florida, the major source of these pollutants is industrial and utility plants.

Sulfur dioxide from smoke stacks and other methods of emission entering the atmosphere are absorbed by plants through the respiratory process and if in excess it may become toxic to plants (Seneca and Tausig 1979). While in the upper atmosphere, sulfur dioxide combines with moisture and falls to earth as acid rain. Acid rain bleaches the soil, rendering many of its minerals inert and incapable of supplying needed nutrients to plants. The result is decreased productivity and increased cost to the farmer. Acid rain also damages leaves and roots. A comprehensive study of acid rain and its impact on the environment was begun in 1978 by the Florida Department of Environmental Regulation (DER).

In the 1950's and the 1960's, fluorides and ozone caused considerable damage to crops and beef cattle in South Florida where substantial amounts of fluoride were released from phosphate mining. Fluorides and ozone enter the leaf system and interfere with photosynthesis and plant food production. When plants laden with fluorides are eaten by livestock, the animals contract fluorosis. Fluorosis symptoms are loss of weight, reduction of growth, lack of mobility, and sometimes death. Ozone damages the leaves and plant cells

and destroys plant life. Ozone pollution is most evident in heavily industrialized areas.

Water Use

Water use is a seasonal concern, not only to farmers in Northwest Florida, but to all inhabitants. The combination of droughts, irrigation, phosphate mining, industrial use, and urban use have periodically created water shortages. In the the future, greater competition between agricultural and non-agricultural water use may cause local short-term water shortages. Water resources are valuable to Northwest Florida, and future use and allocation will probably be determined by government action. Seasonal shortages of water may pose a serious challenge to area farmers. To overcome this threat, farmers are likely to seek new methods of irrigation, water retention, and and water management.

AGRICULTURE'S IMPACT ON THE ECONOMY

Economic indicators that measure the performance or impact of agriculture and other sectors range from aggregate indicators to multipliers. Aggregate indicators such as employment and income are measures of economic activity. Multipliers are used to predict economic change as the sector grows or declines.

In a recent study (Loehman and Hsiao 1979), the value of income, output, employment, and import multipliers was calculated for Florida to express economic change per dollar of final demand. Final demand consists of the demand (purchase) of goods at the retail level.

OUTPUT AND OTHER MULTIPLIERS

Output multipliers give an estimate of the change in total output (dollar value) per change in final demand. In 1970, the agriculture and forest products processing sector in Florida had four of the top five ranked multipliers (ranked by size of multiplier). These subsectors included frozen package foods, paper products and processing, meat and milk processing, and fish processing. Primary production multipliers are listed in Table 14.

For each dollar increase in final demand (in and out of Florida), the dollar value of output related to farm production (i.e., support servies, processing, etc.) will increase 47.7% for livestock, 40.0% for field crops, 37.9% for vegetables and sugar, 36.8% for fruits and nuts, and 26.7% for forest and nursery products. The dollar value of agricultural output will increase 53.8%.

Income Multipliers

The fruits and nuts industry has the highest income multiplier. When demand and output increase by one dollar, the region's income should increase by a multiplier of 1.397 for fruits and nuts, 1.380 for vegetables and sugar, 1.370 for field crops, 1.329 for livestock products, 1.292 for forest and nur-

sery products, and 1.329 for agricultural services. If the output increases by $1,000 dollars in the fruits and nuts industry, then direct and indirect income will rise to $1,397.

Employment Multipliers

These multipliers are obtained by dividing the total employment in all sectors of the economy by direct employment per dollar of output. Field crops have the largest employment multiplier. When demand for agricultural commodities increases by one dollar, the impact on employment is a multiplier of 1.749 for field crops, 1.353 for fruits and nuts, 1.308 for livestock products, 1.253 for vegetables and sugar, 1.220 for forest and nursery products, and 1.242 for agricultural services.

Export Multipliers

An increase in employment in basic industry will have a secondary impact on nonbasic industries. This secondary impact is known as the export multiplier. The rate of growth is determined by its function as an "exporter" outside the region. Export of products from Northwest Florida channel outside dollars into the region and trigger chain reactions of additional economic activity. The process of each dollar being re-spent and causing new impacts is not infinite. At each round of the spending process, some dollars leak out of the economy in the form of savings, taxes, profits to stockholders outside the region, and as payments for imported goods and services. The process associated with each additional dollar of sales is called the "multiplier" effect. Multipliers are useful to predict economic expansion due to growth in sectors of the economy.

According to Loehman and Hsiao (1979), there are various economic indicators which can be used to analyze the role of economic sectors in the economy. The various aggregate indicators and multipliers relate to different aspects of economic welfare. A sector with low output multipliers may be important to the economy because of large numbers of people employed. On the other hand, a sector with low employment may have high multipliers and hence be important in an expansionary sense.

Table 14. Agriculture output multipliers (Loehman and Hsiao 1979).

Commodity	Output multiplier
Agricultural services	1.538
Livestock products	1.477
Field crops	1.470
Vegetables and sugar	1.379
Fruits and nuts	1.368
Forest and nursery	1.267

Table 15. The contribution of agriculture to the Florida economy in 1970 based on employment, personal income, and values that relate to basic agriculture (Loehman and Hsiao 1979) percentage contributions to the State total are given in parentheses.

Sector	Employment relating to basic agriculture (x 1,000)	Personal income ($) relating to basic agriculture (x 1,000)	Value ($) added relating to basic agriculture (x 1,000)
Basic agriculture			
Agricultural services	12,527	53,760	85,606
Livestock products	29,080	166,219	126,429
Field crops, tobacco	4,551	57,648	61,484
Fruits and nuts	28,414	136,914	177,843
Vegetables and sugar	22,191	79,266	102,877
Forest, greenhouse and nursery	9,435	40,354	62,192
Fishery products and forestry	1,566	7,104	8,099
Subtotal	107,764 (5.6)	541,267 (4.8)	624,530 (3.3)
Employment related to agriculture			
Mining	262 (0.0)	1,896 (0.0)	7,442 (0.0)
Construction	1,480 (0.1)	10,544 (0.1)	16,529 (0.1)
Food and wood processing	86,787 (4.5)	539,656 (4.8)	1,090,927 (5.7)
Other manufacturing	10,335 (0.5)	72,994 (0.7)	107,055 (0.6)
Utility and transportation	7,432 (0.4)	56,941 (0.5)	147,463 (0.8)
Trade	18,393 (1.0)	119,662 (1.1)	118,201 (0.6)
Finance, insurance, real estate	3,391 (0.7)	21,731 (0.2)	75,433 (0.4)
Services	12,614 (0.7)	74,335 (0.7)	71,921 (0.4)
Government and ordinance	368 (0.0)	3,620 (0.0)	1,875 (0.0)
Subtotal	141,062	901,379	1,636,846
TOTAL	248,826	1,445,646	2,261,376
Ratio of total to basic	2.61	2.96	4.20

Loehman and Hsiao (1979) have further pursued the subject of agriculture's impact on the Florida economy. Multiplier analysis often understates a sector's full impact because it measures only changes dealing with final demand. Tables were constructed showing the breakdown of basic agricultural sales to processing and final demand for 1963 and 1970. Fishing and forest products have a low output multiplier (1.239), but this is because over 90% of sales are to processers and very little to final demand. When the related processing sectors are examined, they have high multipliers and large exports. All but three of the food and wood processing sectors rely solely on agriculture. In 1970, total employment attributable to agriculture comprised 16.7% of the State's total work force, whereas basic agricultural employment was only 7.7%. Personal income related to agriculture was 21.1% of total income, although personal income derived from basic agriculture was only 13.5% of the State's total personal income. The findings of Loehman and Hsiao on Florida's agricultural sectors' impact on the economy are reported in Table 15. In all sectors the writers believe that the impact of agriculture on other sectors is much less in Northwest Florida than in other areas of the State. This is because the region is not a major producer of many of the State's farm products and also because of its lack of a well developed and sophisticated industrial and commercial base.

AGRICULTURE AND OCS OIL AND GAS DEVELOPMENT

Although currently there are few interactions between the agricultural sector of Northwest Florida and OCS oil and gas exploration and development, two potential threats should be considered. The start of intensive offshore drilling could exact new demands on the labor market. The relatively higher wages of oil workers, approximately $12 per hour (Charter Oil Co. August 1982) as compared to farm hands, $3.34 per hour in 1980 (Greene et al. 1980) would attract farm workers and possibly cause a temporary labor shortage.

Long term and potentially the most costly conflict between agriculture and OCS oil and gas production is the prospect of increased air pollution from refineries built locally (see reports in this volume about minerals and oil production, and environmental issues and regulations). Sulfur dioxide is one of the main pollutants emitted during oil refining and heavy concentrations kill plants. Sulfur dioxide in gaseous form combines with moisture in the atmosphere and forms acid rain. Acid rain can seriously acidify natural, unbuffered fresh waters or leach the soil and damage roots and leaves (Florida Sulphur Oxides Study Inc. 1978).

Other than these two potential problems the writer can see no other possible conflicts between OCS oil and gas development and the agricultural sector. The short run labor conflict is the product of an efficiently operating market. The conflict involving air pollution is the result of an externality, where the market does not operate efficiently. It is beyond the scope of this paper to estimate the potential damage from pollution to farmers. In short, it is anticipated that OCS leasing, if it has these impacts, will raise costs for both the farmer and the consumer and may lower yields and output thus raising consumer prices even higher.

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MINERAL AND OIL RESOURCES

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INTRODUCTION

Minerals produced in quantity in Florida are phosphate, petroleum limestone, titanium, ziron, earth concentrates, and cement. The State is one of the world's leading producers and exporters of phosphate. The major import is refined petroleum products. The import and export of minerals contribute substantially to the economy of the State.

This paper focuses on the mineral production in Bay, Escambia, Franklin, Gulf, Okaloosa, Santa Rosa, and Walton Counties of Northwest Florida. A historical and geological perspective is provided together with current and projected production of minerals. In addition to information on mineral production, related issues are discussed such as employment, value of shipments, and potential impacts of mineral production. This information should be useful for environmental planning. Emphasis is placed on onshore facilities potentially needed for Outer Continental Shelf (OCS) oil and gas production. Although there have been no offshore discoveries, potential discoveries warrant the planning for possible onshore impacts. Therefore, much of this chapter provides generic information on OCS oil and gas operations and their potential impacts.

Nonfuel mineral production in Florida contributes significantly to its gross product and has increased sharply since 1940. The value of mineral production increased from about $15 million in 1940 to about $109 million in 1955, an increase of 730%, and to about $1.6 billion in 1977, an increase of 1380% over 1955. By 1978, Florida was the sixth largest nonfuel mineral producer in the United States, and it ranked ahead of the traditional mining states of Arizona, Colorado, and Utah. In 1978, mineral production (excluding fuels) was valued at over $1.0 billion. Phosphate rock was the leading mineral commodity followed by petroleum, cement, and stone (crushed limestone, dolomite, and shell-rock).

In 1978, Florida not only ranked first in the Nation in the production of phosphate rock, it also ranked first in titanium concentrates and zircon, second in fullers earth and rare-earth concentrates, and sixth in stone. Phosphate rock contributed over half (over $600 million) of the State's total

nonfuel mineral value, followed by cement ($110 million), and stone ($118 million). The total value of crude oil, natural gas liquids, and natural gas was $709,053,000, about 39% of the value of all minerals mined. In terms of the State's economy, the principal mineral products in order of value are phosphate rock, crude petroleum, and limestone.

Northwest Florida, located on the northeastern edge of the Gulf of Mexico coastal oil reserves, has several oil wells in production in Santa Rosa County and northern Escambia County. Although offshore exploration in the Destin Dome (approximately 40 miles southwest of Panama City) has not yielded any important finds, the potential still exists for substantial offshore production.

The seven-county area of Northwest Florida has produced few minerals (mostly sand, gravel, titanium ores, and magnesia) until the relatively recent inland oil and gas find in Santa Rosa and Escambia Counties. There have been no important OCS oil and gas discoveries; consequently, much of the data and observation on OCS oil and gas exploration and development in this chapter is generic and relevant to western Florida as a whole.

REGIONAL GEOLOGY

INLAND

Florida has a land area of over 151,800 km^2 (58,600 mi^2), and is the second largest state in the Southeast. It lies entirely within the coastal plain province, a major physiographic division of the United States. It is underlain by sedimentary rock with a thickness of more than 1,200 m (4,000 ft). The surface mantle over much of the State is composed of oils and sands up to 61 m (200 ft) deep (Calver 1957). The location and variety of mineral deposits and industries in Florida are shown in Figures 1 and 2.

The counties in Northwest Florida are underlain by a thick sequence of sedimentary formations. The oldest formation is the Hatchetigbee Formation (Wilcox Group, early Eocene) consisting primarily of clay, with some shale, siltstone, and shaly limestone. The formation averages 96 m (315 ft) and slopes from a depth of over 820 m (2,700 ft) at the Alabama/Florida State line, to less than 305 m (1,000 ft) in the eastern part of the region (Marsh 1966).

The physiography of Northwest Florida is divided into coastal lowlands and uplands. The uplands portion is comprised primarily of gently rolling areas called "sand hills" because of their marine origin (The Planning Design Group et al. 1977). The basic geology of the region consists of relatively young sedimentary formations and most of the coastal lowlands are covered by unconsolidated marine and estuarine terrace deposits of the Pleistocene.

Oil and gas reservoirs in Northwest Florida may be attributed to the Smackover Formation of Jurassic age. The depth of this formation is about 4,633 m (15,200 to 15,300 ft). There are three producing fields and one plugged field in Escambia and Santa Rosa Counties. The largest of these is the Jay-Little Escambia Creek field.

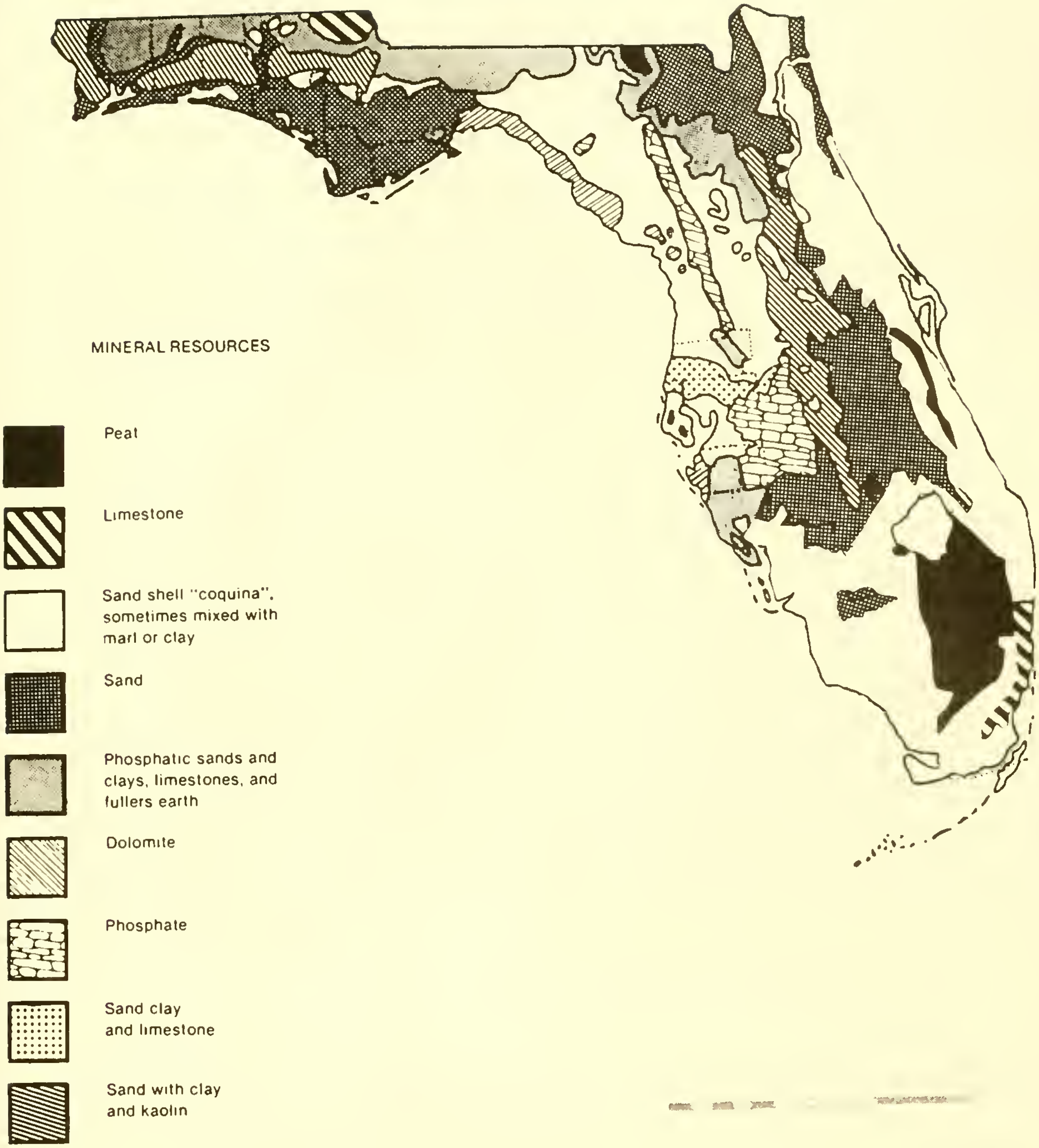

Figure 1. Florida mineral resources (Wood and Fernald 1974).

Figure 2. Florida mineral industries (Wood and Fernald 1974).

Mt. Carmel field is in the upthrown side of the Foskee Fault and is about 305 m (1,000 ft) higher than the Jay field. Sweetwater and Black Jack Creek fields to the southwest of Jay also lie in the downthrown side of the Foskee Fault, an anticlinal trap. According to a 1978 article:

> There is reason for expectation of further development in these fields: The presence of Jurassic salt limestone, and marine shales warrants a continued exploration effort in this embayment. Gravity work and the wells drilled to date, indicate both stratigraphic and structural traps may be present. Further exploration effort, concentrated in those areas which have a thick Smackover section may eventually lead to a commercial oil discovery (Applegate 1978).

Sweetwater Creek Field was plugged and abandoned in December 1980 (Figure 3). Production at the Jay Field and other Northwest Florida fields is expected to decline steadily (Klein 1982). It remains to be seen whether further exploration will take place (Curry and Tootle 1980).

OFFSHORE

Hydrocarbon-bearing formations in the Gulf of Mexico are generally associated with sub-seabed vertical salt movements that form salt domes. Under the weight of the overlying beds, salt is squeezed upwards piercing sedimentary beds and arching those that are closer to the seabed surface into domes. The domes are typically topped by caprock. Oil and gas accumulates along the flanks of these salt domes (U.S. Department of the Interior 1980a).

The West Florida Shelf and Slope extends from the DeSoto Canyon in the Gulf of Mexico eastward to The Straits of Florida in the Atlantic. Geologically, it is considered the submerged extension of peninsular Florida. Most of the oil industry's interest in this area has been in the Destin Dome area, where salt domes and anticlines were the principal exploratory drilling targets. Although wells drilled in the Destin Dome area were dry, a number of piercement domes (diapirs) lie at the head of the DeSoto Canygon. These domes probably will be the center of future exploratory drilling near Northwest Florida.

MINERAL COMMODITIES AND PRODUCTION

The most significant resource in the region, aside from oil, is sand and gravel. The region's largest production comes from Escambia County, most of which is used for construction purposes.

Titanium ores are recovered from sand deposits (most abundant in Escambia County) that contain titanium rich minerals such as ilmenite and rutile. The minerals are concentrated by removing the quartz sand and then separated and purified by electrostatic and magnetic processes (U.S. Army Corps of Engineers 1978). Coastal sands and terrace deposits contain from 3% to 7% heavy minerals. One of two major processing regions of Florida is along the coastal area from Panama City to the Alabama border (Tebeau et al. 1965).

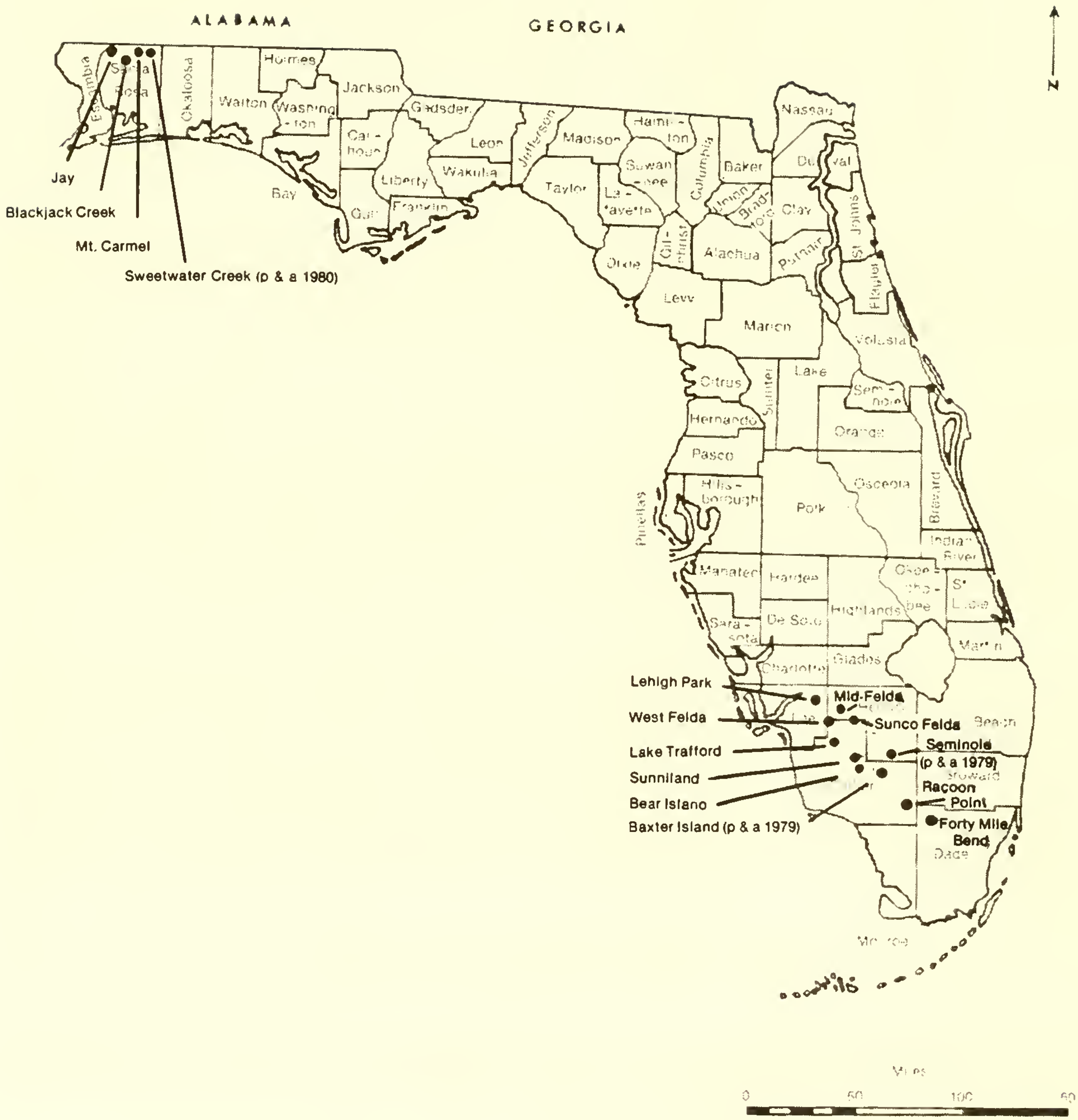

Figure 3. Producing and plugged oil and gas fields in Florida (Curry and Tootle 1980).

A mineral of minor significance is magnesia (MgO), which is recovered from sea water. The basic magnesia plant, located in Port St. Joe in Gulf County, is the only producer of MgO in the region (Florida Department of Pollution Control 1972).

The market value of minerals in Northwest Florida was of little consequence until 1976 when petroleum production in Santa Rosa and Escambia Counties increased sharply. In 1965, Northwest Florida contributed $357,000 (1%) to the State mineral production, and in 1976, it contributed $537 million, 33% of the State total (U.S. Department of Interior 1965, 1979).

In 1967-72 in the State of Florida, the number of businesses in mineral production increased from 210 to 277. Average annual employment increased from 8,100 to 9,000, and wages jumped from $36 million to $53 million. Capital expenditures by the mineral industries in the State (excluding land and mineral rights) were $45 million in 1972 (U.S. Department of Commerce 1973).

Mineral production statistics are incomplete because it is proprietary information not usually made available to the public. No comparable data are available except for Escambia County where the value of mineral production increased from $356,812 in 1960 to $759,000 in 1976. In Bay and Walton Counties, the value of production in 1975 was $474,000 and $290,000, respectively. The number of mineral business establishments in 1972 are given by county in Table 1. Useful information by county is limited because of disclosure rules.

Table 1. Number of mineral producing establishments by county in 1972 (U.S. Department of Commerce 1973).

	Establishments			
County	Oil and gas extraction	Nonmetallic minerals	Total	Number of employees
Bay	4	1	5	0-19
Escambia	14	2	16	20-99
Gulf	2	0	2	0-19
Okaloosa	2	2	4	0-19
Santa Rosa	26	0	26	20-99
Walton	4	0	4	0-19
Northwest Florida	52	5	57	0-19
Florida	--	--	277	--

OIL AND GAS EXPLORATION AND PRODUCTION

HISTORY OF OIL PROSPECTING

Oil prospecting in Florida began at the turn of the century and continued sporadically until the early 1940's when the State's first oil discovery was made in Collier County (Florida Geological Survey 1953). The well drilled at

Sunniland by Humble Oil and Refining Co. began producing on 26 September 1943, but was abandoned on 10 May 1946. A small oil field has been developed at Sunniland since then and continues to produce (Gunter 1952, Vernon et al. 1961).

Offshore oil exploration in Florida was recorded as early as 1947 when the first offshore well was drilled from an artificially created island about 48 km (30 mi) east of Key West. In 1947-53, offshore oil exploration continued in Federal and State waters under nominal Federal and State regulations. In 1953, Congress enacted the OCS Lands Act (67 Stat. 462; 43 USC 1331-1343 ca. 1981) affirming that Federal submerged lands on the OCS seaward of State boundaries would be subject to Federal Government control. On the west coast of Florida, State jurisdiction extends three marine leagues (approximately 17 km or 10.4 mi) from the coastline. The act governs the leasing of offshore tracts for exploration, development, and production of subsea mineral resources. The act provided that the Secretary of the Interior "... is authorized to grant to the highest responsible bidder by competitive bidding under regulations promulgated in advance, oil and gas leases on submerged lands of the Outer Continental Shelf."

In 1959, the first Federal lease sale (L.S. #5) in Florida encompassed the Marqueses areas in the Straits of Florida between the Dry Tortugas and Key West. The sale offered 80 tracts, consisting of 185,425 ha (458,000 acres) of which 23 tracts were leased. Drilling was discontinued in 1963 because of the scarcity of oil.

INLAND PETROLEUM PRODUCTION

More than 50 test wells were drilled in Escambia and Santa Rosa Counties in the 1960's before oil was discovered (Marsh 1966). On 15 June 1970, Exxon, formerly known as Humble Oil and Refining Company, started a 6-hour production test in a well that flowed naturally at a rate of 1,712 barrels of oil and 2.15 million ft^3 of gas per day. This well marked the discovery of the Jay Field. Within four years, the productive surface area of 5,625 ha (13,900 acres) was fully delineated and peak production of 93,500 barrels per day was achieved. The rapid development was the result of cooperation by four major corporations: EXXON, Sun Oil, Amarada Hess, and Louisiana Land and Exploration. The field was the largest inland petroleum find in the contiguous 48 states in twenty years, and it is expected to produce some 345 million barrels of oil during its life (Florida Energy Office 1975).

In 1978, crude oil in Northwest Florida contributed 42,497,000 barrels (89.4%) of the State total of 47,536,000 barrels (Curry 1978). Cumulative oil production in 1970-78 from the Jay field alone was 208.4 million barrels, which is just over one-half the estimated recoverable oil from the Jay field using existing production methods (Florida Energy Office 1975). In addition to crude oil, about 41.8 billion ft^3 of marketable casinghead gas was produced from the four fields in 1978 (Curry 1978). In 1979, oil and gas production declined somewhat. About 42,262,951 barrels of oil and 49,812,460 million ft^3 of gas were produced.

OFFSHORE OIL AND GAS

Interest in oil and gas resources off the Northwest Florida coast began when the Jay field in Escambia and Santa Rosa Counties was discovered in 1970. At that time, the Federal Government was opening frontier areas for exploration in response to the national policy to accelerate oil and gas production in the United States. One such frontier area in the Eastern Gulf of Mexico adjacent to the States of Mississippi, Alabama, and Florida (MAFLA) was created. Following the lengthy leasing process, 62 tracts consisting of 196,516 ha (485,396 acres) were sold on 23 December 1973. Most of the tracts in the so-called MAFLA area were adjacent to Florida (U.S. Department of the Interior 1980b). Bids received exceeded $1 billion, the largest sum ever gained from a lease sale. Drilling permits were issued for 43 of the 62 tracts, but only 14 were drilled and they were dry (U.S. Department of the Interior 1980b).

The area known as Destin Dome, approximately 48-160 km (30-100 mi) southwest of Panama City, is where 32 of the 62 tracts were sold. This area is northeast of the sloping carbonate platform which delineates the OCS and is therefore in relatively shallow water (less than 100 m deep). Although salt structures are associated with oil and gas production throughout most of the gulf coast basin, they are not the dominant exploration sites in the West Florida carbonate platform. In the Destin Dome area, salt anticlines and domes were the exploration targets. Here, porosity traps formed by buried biotherms, reef complexes, and other bodies of detrital carbonates are the principal hopes for oil and gas discovery (U.S. Department of the Interior 1980b).

A second MAFLA sale was made on 18 February 1976. The 34 of the 132 tracts offered that were sold, consisted of 65,297 ha (161,285 acres). Four tracts leased adjacent to Florida were purchased by a consortium of oil companies, but in April 1981, only one drilling permit had been issued and apparently no discoveries were made.

The third MAFLA sale (L.S. #65) on 31 October 1978 leased 35 tracts consisting of 81,495 ha (201,294 acres). It was the first lease sale adjacent to Florida in the Gulf of Mexico subject to the Outer Continental Shelf Lands Act Amendments of 1978 (43 U.S.C. 1351). By April 1981, ten Environmental Impact Reports and Exploration Plans had been filed with the Federal Government of which eight have been approved for drilling. No discoveries yet have been made on the four tracts under exploration.

Other lease sales in the MAFLA area offered tracts adjacent to other states as well as to Florida (Figure 4). Florida's share (40%) of lease sales, in comparison with that for the entire MAFLA area, is given in Tables 2 and 3.

East Bay

Interest in offshore oil and gas development in Northwest Florida has not been limited to the Outer Continental Shelf. Drilling on submerged State-owned lands from floating or fixed platforms dates back to 1947 when the first offshore oil well was drilled near Key West in Monroe County. Since 1947, various oil companies have entered into lease agreements with the State for mineral extraction privileges, primarily oil and gas, within State waters.

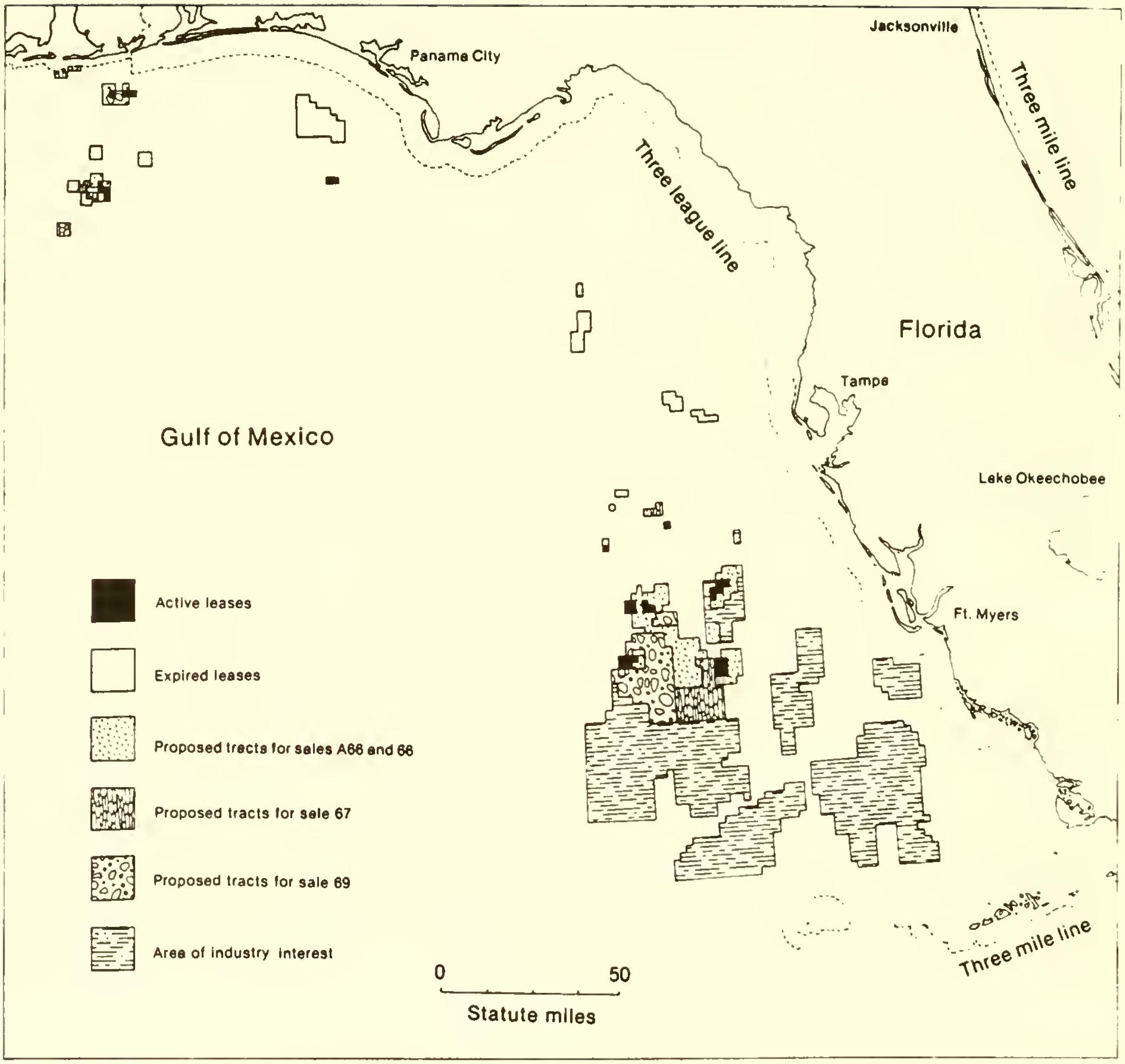

Figure 4. Status of OCS lease areas off the Florida Gulf Coast (U.S. Department of the Interior, Bureau of Land Management 1980a).

The Getty Oil Company's recent interest in East Bay, within Santa Rosa County, may be attributed to the fields discovered at Jay. The drilling site was selected because of its direct proximity to an anticline located in the Smackover and Norphlet geologic substructure of East Bay.

The Getty Oil Company proposes to drill a 5,427-m (17,800-ft) exploratory well near the center of East Bay to determine whether a marketable quantity of oil or gas is present. If proven economically productive, up to eight additional wells will be drilled. According to the oil company, there is a greater likelihood that natural gas, rather than oil, will be discovered and that such a find will have a minimum of 15-year producing period. During that period, Getty Oil estimates expeditures to total $91 million (1979 dollars) for development and production and $43 million in revenues to State and local governments.

Table 2. Lease sales in 1959, 1973, 1976, and 1978 of tracts in Florida and in Mississippi, Alabama, and Florida combined (MAFLA) as reported by the Department of the Interior (1980b).

Lease sale number	Date	Tracts offered for lease		Tracts leased		Percent of offered tracts leased	
		Florida	MAFLA	Florida	MAFLA	Florida	MAFLA
05[a]	02/26/59	80	--	23	--	29	--
32	12/20/73	85	147	62	87	67	59
41	02/18/76	60	132	4	34	7	26
65	10/28/78	71	89	28	35	39	39
Total		296	368	117	156		

[a] L.S. #5 is not considered part of MAFLA, but all leasing activity was adjacent to Florida.

Table 3. Lease sales (in acres) offered and leased in 1959, 1973, 1976, and 1978 for Florida and for Mississippi, Alabama, and Florida combined (MAFLA) as reported by the U.S. Department of the Interior (1980b).

Lease sale number	Date	Acres offered		Acres leased		Percent offered acres leased	
		Florida	MAFLA	Florida	MAFLA	Florida	MAFLA
05[a]	02/26/59	458,000	--	32,480	--	7	0
32	12/20/73	489,600	817,297	357,120	485,396	73	59
41	02/18/76	350,292	687,603	23,040	161,285	7	23
65	10/28/78	408,334	551,709	161,280	201,294	39	39

[a] L.S. #5 is not considered part of MAFLA, but all leasing activity was adjacent to Florida.

Currently (1982), the Getty Oil Company is seeking a ruling from the courts to allow drilling after being turned down by the Florida Governor and Cabinet.

OCS OIL AND GAS PROJECTIONS

Long-term forecasts by USGS for oil and gas production from the Gulf of Mexico call for a gradual decline in production with ultimate depletion sometime after 2000 (Figure 5). Production levels are not independent of technolgoical innovation, economics, and market forces. For example, in old, nearly depleted wells, oil could be forced out by steam injections and increase the recoverable reserves in existing fields. Breakthroughs in oil platform design enabled small, currently uneconomical fields to become profitable. As the complex relationships of technology, economics, and market forces change, estimates of recoverable resources also change.

The Resource Appraisal Group (RAG) of USGS assessed the undiscovered recoverable oil and gas resources and developed the production predictions shown in Figure 5. The RAG and the Office of Resource Analysis (also in USGS) employ occurrence modeling, search modeling, and production modeling to estimate field size distributions and supply curves. Data obtained from this research are being used to develop a sophisticated model of the dynamics of

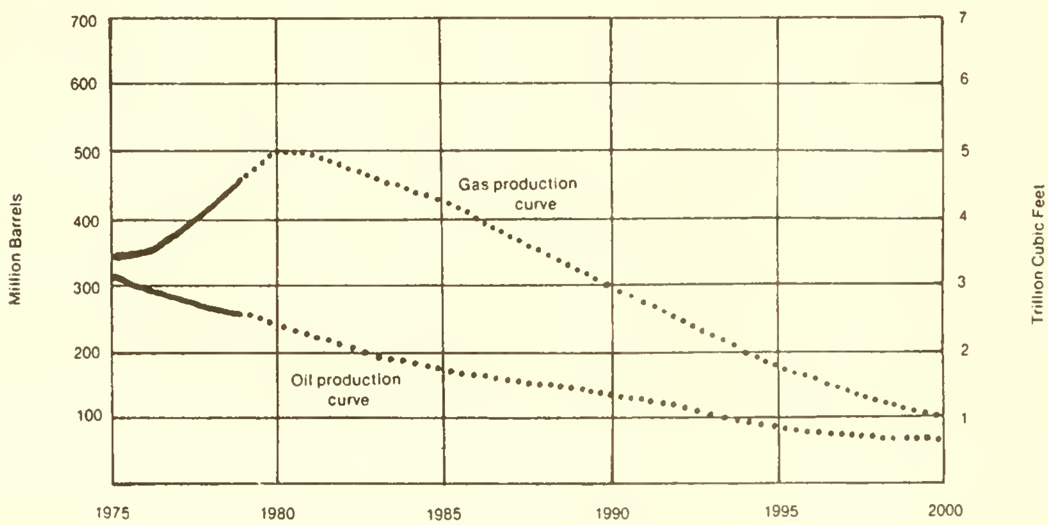

Figure 5. Oil and gas production for the Gulf of Mexico from 1975 to 2000 (U.S. Department of Interior 1980a, 1980b).

petroleum reserves. The Clark-Drew Model is capable of determining (1) the field size distribution of total resources, (2) field size distribution of deposits discoverable at different levels of cost and technology, and (3) production curves over time using various socioeconomic assumptions (U.S. Department of the Interior 1980a).

The Clark-Drew Model indicates that there are over 1,000 fields and/or reservoirs yet to be discovered in the Gulf of Mexico. Half of them would likely be small, each perhaps containing less than one million barrels of recoverable oil.

Under suitable market conditions and technological innovations, these fields could be profitably brought into production. The oil and gas produced would not cause any great increase in oil and gas production, but the date of ultimate depletion could be extended. There are no published estimates of oil and gas reserves in the eastern Gulf of Mexico.

Resource and Reserve Estimates

The USGS is responsible for estimating oil and gas reserves on the Outer Continental Shelf. For this purpose, USGS conducts geophysical studies and reviews data gathered by oil and gas companies under prelease exploratory permits, or as a result of exploration and development conducted on leases obtained from the government.

The most recent estimates of oil and gas reserves were made by USGS. Their estimates are based on undiscovered recoverable oil and gas in October 1980, and known remaining recoverable reserves in January 1979 (Table 4).

Table 4. Gulf of Mexico OCS oil and gas reserves (mean estimates) in 1979 (U.S. Department of the Interior 1980b).

Gulf area	Oil (billion bbl)[a]	Gas (trillion ft^3)
Mean estimates of undiscovered recoverable reserves		
Western Gulf of Mexico (Main pass area and west) 0-2,500 m water depth	5.2	69.0
Eastern Gulf of Mexico (East of Main pass area) 0-2,500 m water depth	1.3	2.9
Known reserves	2.8	37.2

[a]bbl = barrel = 42 U.S. gallons

Original recoverable reserves represent the amount of oil and gas before exploration, development, and production. They equal the total production that could be expected from a field. The original recoverable reserves in the Gulf of Mexico are estimated by USGS to have been 7.52 billion barrels of oil and 76.2 trillion ft^3 of gas. More than three decades of production yielded 4.76 billion barrels of oil and 39 trillion ft^3 of gas (U.S. Department of the Interior 1980b).

The most recent undiscovered recoverable reserve estimates for the Gulf of Mexico are 6.5 billion barrels of oil and 71.9 trillion ft^3 of gas.

OCS OIL AND GAS EXTRACTION FACILITIES

INTRODUCTION

The exploration, development, and production of oil and gas resources on the Outer Continental Shelf (OCS) involves a variety of unique onshore facilities. Generally, in frontier areas like the eastern gulf, OCS-related activities are performed by an imported specialized industrial group. Firms specializing and experienced in OCS oil and gas activities usually establish operations in a coastal area adjacent to offshore exploration and production areas if the scale of offshore activities provides the necessary economic incentive. The economic requirements for certain types of OCS onshore facilities (refineries, processing plants, and fabrication yards) are such that in many cases, a high level of onshore facilities and services are necessary to support oil and gas recovery. If the production of offshore OCS oil and gas is so small that new onshore facilities are not justifiable, then the offshore operations probably will be serviced by existing onshore facilities in Texas or Louisiana.

Even if OCS oil and gas exploration and production are low, some small onshore facilities such as service bases, heliports, and inspection and testing companies probably will locate along the Florida coast. Most of these specialized firms are involved in OCS operations worldwide, but there may be limited economic opportunities for local industries, such as machine shops, labor contractors, and trucking companies. Industries serving port areas also are likely to benefit.

PHASES OF OCS OIL AND GAS ACTIVITIES

The six phases of OCS activities are: (1) tract selection, (2) leasing, (3) exploration, (4) development, (5) production, and (6) shut down. Although completion of these phases may take 15 to 40 years, there is considerable overlay among the phases. With the exception of geophysical and geological exploration there is little need for onshore facilities or services during the leasing phase.

The exploration phase usually lasts from 1 to 7 years (New England River Basin Commission 1976a). Temporary service bases are established, generally in existing ports, to service and support exploratory drilling. Only small

onshore support is required during exploration, most of which would be temporary. Exploration requries service bases and suppliers of tubular goods and drilling supplies such as muds and cement.

The development phase lasts from 4 to 9 years after oil and gas are found in commercial quantity (New England River Basin Commission 1976a; 1976b). Development drilling is usually performed from fixed platforms floated to the site and positioned on the ocean floor. Onshore activities peak during the development phase. Permanent service bases are established and oil/gas transporation systems are implemented. Tool and equipment companies, catering services, repair and maintenance yeards, diving companies, and specialized drilling equipment companies would be located onshore.

As well drilling is completed, the production phase begins. This phase lasts 10 to 25 years or more. During this phase, the drilling rig is disassembled and production equipment installed. Oil may be pumped ashore by pipeline or stored offshore until it is transferred to tankers. Market conditions in adjacent coastal areas will dictate whether the crude oil will be refined in Florida or trans-shipped out of the State. Gas must be piped to shore for processing and transport. If applicable, a gas processing plant may be constructed inland between the OCS pipeline landfall and the existing gas infrastructure.

There are virtually no new onshore activities generated during the shutdown phase. Facilities identified above are closed or shifted to other uses or areas.

LOCATION FACTORS FOR ONSHORE FACILITIES

Proximity to offshore OCS oil and gas activities is generally the most important factor in determining the location of onshore facilities. Another important consideration is the tendency for OCS support activities to aggregate, or locate in a central geographical area, usually in a port area. The tendency to cluster near other related industries is necessary for adequate cooperation and interaction among the support activities. Economic efficiency may be achieved by minimizing the duplication of facilities and equipment.

A number and diverse assortment of onshore support facilities are required to support offshore OCS operations. Some of the major factors affecting the number and location of these facilities are listed in Table 5.

FACILITY REQUIREMENTS

The following section describes typical onshore OCS facilities, siting considerations, and environmental impacts.

Service Bases

Service bases are used for fabricating, servicing, and storing drilling equipment, platforms and pipes, and supplying personnel and transportation to and from oil and gas rigs and platforms.

Table 5. Factors affecting the number and locations of onshore support facilities (New England River Basins Commission 1976a; 1976b).

Location of oil and gas field
Size of oil and gas field
Topography of oil and gas field
Depth of water
Whether both oil and gas are found
Availability of coastal frontage (land)
Availability of additional (back-up) land
Proximity of existing refineries and processing plants
Proximity to diverse urban areas and markets
Public services and facilities (schools, hospitals)
Labor markets (areas without strong labor unions are preferred)
Public opinion
Availability of entertainment
Proximity to airport or landing strip

Service bases require at least two berths, each about 122 m (400 ft) long per rig. Fewer vessels and helicopters may be required if several rigs are serviced from the same service base. Depending on the distance to the rig and the nature of offshore OCS operations, at least two vessel trips and one helicopter trip per rig are required daily. The typical types and quantities of materials transported offshore to a drilling rig in one year are shown in Table 6.

Temporary service bases are established as soon as exploration and early development begin. Temporary bases may be expanded into permanent service bases, but only if a significant discovery of oil or gas has been made. Pipeline installation service bases locate during the latter part of the development phase; preferred locations are pipeline landfall sites and pipe casting yards. Preferred locations for platform installation service bases are sites within close proximity to where platform installation will occur.

Transportation Facilities

Pipelines are the preferred method of transporting oil from offshore to onshore locations although tankers sometimes are used. Gas is always transported by pipeline. The locations of pipelines usually depend upon decisions based on distance from shore (the shorter the better), and environmental considerations, e.g., ocean bottoms, and landfall beaches. The location, costs and suitability of pipeline easements also are important considerations. Usually the production threshold that must be met to justify the construction of a pipeline is 70,000 bbl per day for oil and 500 million ft^3 per day for gas.

Table 6. Types and quantities of materials transported annually offshore to an exploration rig (New England River Basins Commission 1976b).

Materials	
Type	Quantity
Fuel	10,000-15,000 bbl
Drilling mud	2,000-5,000 tons
Cement	1,000-3,000 tons
Fresh water	5,000,000-7,500,000 gal
Tubular goods	2,000-3,000 tons

Pipeline construction and operations require a number of onshore support facilities including pipe coating yards, service bases, testing and inspection services, diving companies, and survey teams. Pumping stations are sometimes required, and, depending on the final destination of the oil or gas, a refinery, processing plant, marine terminal, or storage facilities may be necessary. Siting considerations and requirements of facilities directly associated with pipelines are listed in Table 7. Impact considerations are given for onshore support facilities for OCS oil and gas development (Table 8).

Marine Terminal Facilities

Marine terminals in Florida will most likely receive crude oil from offshore pipelines during a major portion of the production phase. During the earlier stages of production, small tankers (16,000 to 25,000 deadweight tons) may be used. Until quantities of gas are found to be large enough for production, gas is either flared or reinjected into the well.

Terminal facilities vary depending on their particular needs and the availability of waterfront. Berthing facilities may include offshore moorings, fixed island piers, fixed shoreside piers, floating T-piers or other methods. Site considerations and impacts associated with onshore development are given in Tables 9-10.

Processing Facilities

Crude oil produced at the wellhead requires processing to separate oil, natural gas, brine, water, and suspended and dissolved solids. The processing takes place at the well site, onshore, or both. The nature and location of facilities that will be used to separate the ingredients from the wellstream depend on the characteristics of the ingredients and transportation.

The first step is to remove impurities and separate gas and, in some cases, water from the wellstream. Gas found in a free state with little or no oil present is termed non-associated gas. Non-associated gas may be reinjected or piped inland for sale. Associated gas (which is found in solution

Table 7. Requirements for onshore support facilities for OCS oil and gas development (adapted from New England River Basin Commission 1976b).

Facility	Requirements
Service bases	
Land	
Temporary base	2-6 ha (5-15 acres)
Permanent base	10-40 ha (25-200 acres)
Berthage	61-183 m (200-600 ft) water frontage 5-6 m (15-20 ft) water depth
Transportation	Air-heliport very close proximity Water-excellent vessel accessibility Rail-desirable Road-adequate accessibility
Economic base	Cost of land Proximity to related industries
Pipelines	
Land	
Pipeline easement (on shore)	15-30 m (50-100 ft)
Pipecoating yard	20-61 ha (50-150 acres)
Pumping station (if required)	16 ha (40 acres)
Waterfront	15-30 m (50-100 ft) for landfall 229 m (750 ft) for pipecoating yard (water depth at least 3 m or 10 ft)
Water	11,350-56,775 liters (3,000-15,000 gal/d)
Berthing facilities	
Land	
Terminal	20-30 ha (50-75 acres)
Tank farm	8-30 ha (20-75 acres)
Berthage	Approximately 304 m (1,000 ft) for pier
Water	Potable water Purging
Oil and gas processing	
Land	20-30 ha (50-75 acres)
Water	200,000-750,000 gal/d

(continued)

Table 7. (Concluded).

Facility	Requirements
Refineries	
Land	202-809 ha (500-2,000 acres)
Water	5-10 million gal/d
Platform fabrication	
Land	10-324 ha (25-800 acres)
Berthage	61-122 m (200-400 ft) 5-15 m (15-50 ft) depth
Water	40,000-100,000 gal/d

Table 8. Potential pollutants and the economic base for onshore support facilities, OCS oil and gas development (adapted from the New England River Basins Commissions 1976b).

Facility	Pollutants/economic requirements
Service bases	
Type of pollution	
Air emission	Hydrocarbons Carbon monoxide Nitrogen oxides
Wastewater contaminants	Hydrocarbons Heavy metals
Solid wastes	Up to 6 tons per day during drilling Hazardous wastes, contaminated oil
Noise	Up to 85 dBA[a] on a 24-hour basis
Economic base	
Labor	50-60 jobs/platform during drilling 20-30 jobs/platform during production
Wages	$750,000-$1,000,000/year
Capital investment	Temporary base - $200,000-$300,000 Permanent base - $2 million-$5 million

(continued)

Table 8. (Continued).

Facility	Pollutants/economic requirements
Pipelines	
Type of pollution	
Air emission	Hydrocarbons Sulfur oxides Nitrogen oxides Particulates Carbon monoxide
Wastewater contaminants	Alkaline substances Hydrocarbons Particulates Metal fragments
Solid wastes	Concrete Contaminated debris Packaging materials Metal scraps
Noise	Up to 100 dBA[a] on a 24-hour basis
Economic base	
Labor	250-300 jobs/pipeline during construction 100-200 jobs at pipecoating yard during construction
Wages	$5 million-$6 million/year for pipeline construction $1.5 million-$3 million for pipecoating yard during construction
Capital investment	$8 million-$10 million for pipecoating yard
Berthing facilities	
Type of pollution	
Air emissions	Hydrocarbons Carbon monoxide
Wastewater contaminants	Oil and grease High BOD (Biochemical Oxygen Demand) High COD (Chemical Oxygen Demand)

(continued)

Table 8. (Continued).

Facility	Pollutants/requirements
Berthing facilities (continued)	
Economic base	
Labor	25-75 jobs
Wages	$500,000-$1,000,000/year
Capital investment	$15 million-$20 million
Oil and gas processing	
Type of pollutants	
Air emissions	Carbon monoxide Hydrocarbons Hydrogen sulfides Nitrogen oxides Particulates Sulfur oxides
Wastewater contaminants	Oil and grease Heavy metals Phenols Halogens Chromium Sulfuric acid Phosphates Chlorine Zinc
Noise	Up to 100 dBA[a] on a 24-hour basis
Solid wastes	Scale and sludge Oil absorbants Spent desiccants
Economic base	
Labor	50-60 jobs
Wages	$750,000-$1,000,000/year
Capital investment	$50 million-$100 million

(continued)

Table 8. (Concluded).

Facility	Pollutants/economic requirements
Refineries	
Type of pollution	
Air emissions	Ammonia Aldehydes Carbon monoxide Hydrocarbons Particulates Sulfer oxides
Wastewater contaminants	Acids and caustics Floating and dissolved oil Dissolved solids Dissolved organics Cyanide Chromate
Economic base	
Labor	200-600 jobs
Wages	$6 million-$10 million/year
Capital investment	$5 million-$25 million
Platform fabrication	
Type of pollution	
Air emissions	Sand and metal dust Concrete and cement dust Nitrogen oxide Sulfur oxide Hydrocarbons Organic compounds
Wastewater contaminants	Heavy metals Chemicals Particulates
Noise	Up to 100 dBA[a] on a 24-hour basis

[a] Measure of the intensity of sound.

with oil), if found in large enough quantities to justify the construction of a pipeline, is transported ashore for further processing and to recover liquifiable hydrocarbons.

In some cases the entire wellstream is piped ashore. There is a tradeoff here, however, between using the larger pipe size needed to carry the increased volume (because of free water) versus the use of valuable platform space for water separators. Emulsified water is usually separated out of the wellstream onshore because equipment necessary for this process is relatively complex. Both free and emulsified water must be treated before discharge. The siting considerations and impacts of onshore oil and gas processing and treatment facilities are shown in Tables 9 and 10.

Refineries

A modern oil refinery physically or chemically alters all or part of crude oil to produce a number of petroleum products. The three major types of refineries are market refineries built to serve a particular market, resource refineries built on or near major oil fields, and swing refineries built to balance supply and demand. The market refinery is the preferred type of refinery because shipping bulk crude oil is less costly than shipping several refined products. Refineries are not usually constructed to accommodate OCS production area unless a relatively large demand is located nearby.

Refineries usually are parts of complexes that also include storage tanks, administration and maintenance facilities, water treatment facilities, and laboratories. The entire complex is usually surrounded by a buffer zone. Transportation systems including rail, road, pipelines, and marine terminals also are required, Siting considerations and impacts associated with refineries are given in Tables 9-10.

Platform Fabrication Yards

Offshore OCS oil and gas drilling and production are conducted from platforms that are constructed of steel or concrete. The main body, or jacket, supporting the platforms is constructed almost entirely of tubular steel that is fabricated onshore at a waterfront location, placed in the water and towed to the installation site, and set in place on the ocean floor. Decks, drilling rigs, living quarters, and other rig components also are constructed onshore and towed to the offshore site. Several types of platforms are constructed depending upon depth, sea bottom type, weather trends, the mix and type of oil and gas in the find, and other factors.

Platform fabrication yards are large marine facilities usually consisting of fabrication shops, welding racks, pipe mills, concrete mixing plants, and cement storage silos (if concrete platforms are used), and administrative facilities (Tables 9-10).

Table 9. Siting requirements for berthing facilities, oil refineries, platform fabrication yards, and processing facilities for onshore support for OCS oil and gas development in Northwest Florida (adapted from New England River Basins Commission 1976b).

Facility	Requirement
Berthing facilities	
Land	
Terminal	20-30 ha (50-75 acres)
Tank farm	8-30 ha (20-75 acres)
Berthage	About 304 m (1,000 ft) for pier
Water	Potable water Purging
Oil refineries	
Land	202-809 ha (500-2,000 acres)
Water	5-10 million gal/d
Platform fabrication yards	
Land	10-324 ha (25-800 acres)
Berthage	61-122 m (200-400 ft)
Water	40,000-100,000 gal/d
Oil and gas processing facilities	
Land	20-30 ha (50-75 acres)
Water	200,000-750,000 gal/d

Table 10. Impact considerations for berthing facilities, oil refineries, platform fabrication yards, and processing facilities for onshore support for OCS oil and gas development in Northwest Florida (adapted from New England River Basin Commission 1976b).

Facility	Pollution/economic requirements
Berthing facility	
Type of pollution	
Air emissions	Hydrocarbon Carbon monoxide
Wastewater	Oil and grease High biochemical oxygen demand (BOD) High chemical oxygen demand (COD)
Economic base	
Labor	25-75 jobs
Wages	$500,000-$1,000,000/year
Capital investment	$15 million-$50 million
Oil refineries	
Type of pollution	
Air emissions	Ammonia, aldehydes, carbon monoxide, hydrocarbon, particulates, sulfur oxides
Wastewater	Acids and caustics, floating and dissolved oil, dissolved solids, dissolved organics, cyanide, chormate
Economic base	
Labor	200-600 jobs
Wages	$6 million-$10 million/year
Capital investment	$5 million-$250 million

(continued)

Table 10. (Concluded).

Facility	Pollutants/economic requirements
Platform fabrication yards	
Environmental	
Air emissions	Sand and metal dust, concrete and cement dust, nitrogen oxide, sulfur oxide, hydrocarbons, organic compounds
Wastewater	Heavy metals, chemicals, particulates
Noise	Up to 100 dBA[a] on a 24-hour basis
Oil and gas processing facilities	
Environmental	
Air emissions	Carbon monoxide, hydrocarbons, hydrogen sulfide, nitrogen oxides, particulates, sulfur oxide
Wastewater	Oil and grease, heavy metals, phenols, halogens, chromium, sulfuric acid, phosphates, chlorine, zinc
Noise	Up to 100 dBA[a] on a 24-hour basis
Solid wastes	Scale and sludge, oil absorbants, spent desiccants
Economic base	
Labor	50-60 jobs
Wages	$750,000-$1,000,000/year
Capital investment	$50 million-$100 million

[a] Measure of the intensity of sound.

SUMMARY

The mineral production of Northwest Florida recently has increased substantially during the past few years because of the oil fields near Jay. Oil and gas produce much greater revenue in the region than all other minerals combined, and they now account for about one-third of the value of all mineral production in the State. Hopes were high in the mid-1970's that offshore oil and gas would be found in the Destin Dome southwest of Panama City, but no significant amount was discovered. Nearshore, there is expectation of a gas find in East Bay, but exploration may not begin for years.

Nonfuel mineral production is low. Sand and gravel are most valuable, and Escambia County has the largest production. Ilmenite and rutile are produced from coastal sands west of Panama City, and magnesia is extracted from sea water at Port St. Joe.

OCS oil and gas exploration off the Gulf coast of Florida is nearly at a standstill, but further explorations are expected. If significant offshore production takes place, the onshore requirements for facilities such as refineries, processing plants and fabrication yards may be extensive. It is important for State and local governments that may be affected to anticipate and plan for such developments.

DATA GAPS

Northwest Florida is not a major mineral producer. Nonfuel minerals are usually produced by only one firm in a county. Nondisclosure rules cause difficulties in obtaining production statistics for several counties and several minerals.

Information on employment is provided in broad categories by the Bureau of Census. Employment in mineral industries in Northwest Florida is grouped in ranges of 0-19 to 20-99 employees and such data are of little use when evaluating the economic significance of the mineral industry. The infromation required above cannot be obtained from the Bureau of Census because of nondisclosure rules. If such information is needed, it will have to be obtained in a way that alleviates disclosure problems, if possible.

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RECREATION AND TOURISM

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INTRODUCTION

The purpose of this report is to synthesize data on tourism and and outdoor recreation in Escambia, Santa Rosa, Okaloosa, Walton, Bay, Gulf, and Franklin Counties in Northwest Florida. The data and analyses will be used to help assess the potential impacts of OCS oil and gas development on tourism and outdoor recreation. The sections on the State of Florida overview and the potential impacts of oil and gas exploration and development in this report, and its companion report for Southwest Florida, are similar and are intended to be so.

Recreation is a major use characteristic of coastal Florida. According to the Natural Resources Defense Council (1976), coastal recreation per capita is 10 days annually. Sport fishing attracts millions of resident and out-of-state (tourist) saltwater anglers, and is a multimillion dollar a year business. Hunting, surfing, boating, skin diving, beach recreation, and nature studies are popular coastal activities. In recent decades the demand for recreation has been increasing, but opportunities have been declining. Only a small fraction of Florida's coastline is now available for public recreation and some of the finest and more accessible areas are being developed for other uses.

The rapid population growth, urbanization, urban sprawl, the automobile, and new highways have reduced the amount of land available for recreation. Each year it becomes more expensive and more difficult to obtain new areas for playgrounds, parks, forests, wildlife management areas, scenic routes, and fish and wildlife preserves.

Water resources are in need of a comprehensive program of restoration and expansion. The problems caused by water pollution, sedimentation and dredge and fill operations, have reduced the value of coastal waters as recreation areas. As Floridians and tourists increase their mobility, disposable income, and leisure time, their demands for recreation and tourism also increase. The consequences are that many different interest groups are likely to compete for the use of a limited supply of resources.

Perhaps the most visible problem created by a rapidly shrinking natural coastline is that of public access to fishing grounds (Hinman 1978). Sewage disposal and silt-laden runoff from dredge and fill navigation projects usually increase turbidity and lead to deleterious effects on estuarine and near-shore fisheries. Most fisherman must venture farther offshore to less polluted water, which leads to a greater expenditure of time and money. Bell (1978) states that increasing population, higher real per capita incomes, shorter work weeks, and longer vacations mean more leisure time and money for outdoor recreation. The effect of increasing demand and dwindling supply will

most certainly raise the real value of sport fishing. The terms sport fishing and recreational fishing are used interchangably in the literature; for continuity in this report, sport fishing, or sport fish, is used.

Since 1979, one of the major economic issues in Florida has been the tourist industry. Although tourism has been confronted with inflation and high energy costs, the industry is still strong and the natural resources that provide recreation for tourists must be protected.

STATE OF FLORIDA OVERVIEW

Compared to the Nation as a whole, the population growth of Florida over the past 30 years has been a dramatic one. The U.S. population grew 45% from 1950 to 1979, but Florida's population grew over 300% (2.7 million to 9.2 million). Part of Florida's increase was caused by the influx of retirees. The number of retirees in the population increased from 11% to 18% in 1960-79 (9% to 11% nationwide).

The population of Florida in 1980 was 9.7 million, a 43.7% increase since 1970. The average rate of increase was 3.7% per year (1980 U.S Census data from Florida State University computer tape). In the 1970's, Florida was the third fastest growing state in the country behind Nevada and Arizona. Despite the 1980 recession, tourism in Florida did not decline as it did in the recession in 1974-75. In 1974, there was a decline in out-of-state cars, but the number of tourist arrivals actually increased. As gasoline prices and the cost of air travel increase, combined with the slow growth in real income, tourism in Florida is likely to level off. The tourist predictions for 1981 are about 33.3 million, a 1.7% increase over 1980.

In 1989, Florida can expect over 48.4 million tourists. This is 15.3 million more visitors than in 1979. The annual projected tourist growth rate in 1979-89 is 3.9% compared to 6.6% for the previous decade.

The impacts of recreation and tourism on Florida's economy are reflected by the sales of nondurable goods. Sales of recreation-related nondurable goods ($10 billion statewide) were 18% of total taxable sales in 1979. The 1989 forecast shows $30 billion or 18.72% of the State total. Recreation nondurable taxable sales in Florida were $2.7 billion in 1968, $3.4 billion in 1970, $5.8 billion in 1975, and $8.6 billion in 1978.

Florida has become the mecca for outdoor recreation seekers throughout the United States and it is rapidly becoming one of the most popular winter vacation spots for Europeans and other foreigners as well (Florida Department of Natural Resources 1981). Each year over 33 million tourists visit Florida to take part in outdoor recreation and as Florida's population grows, there will be a need for additional outdoor recreation services and facilities. Although residents in urban areas engage in user-oriented recreation more than resource-oriented recreation, urbanites are expected to make greater demand on resource-based recreation in the future, which will require further public purchase of the natural lands and waters.

Florida's climate is temperate in the northern part of the State to subtropical or tropical in the south. Year-round temperatures are suitable for outdoor recreation throughout the State (Figure 1). Florida has over 54,000 mi^2 of land area and 15,000 mi^2 of territorial waters and estuaries. Territorial waters make up 85% of the total and estuaries (bays, lagoons, and marshes) make up the other 15%.

Florida has a wealth of natural resources that support outdoor recreation. The State has 22 major natural springs that discharge over 3 billion gallons per day (Bgal/d) to form lakes and rivers. The combined flow of all springs in Florida is about 5 Bgal/d. Florida's 7,700 lakes comprise over 3,200 mi^2 of water area, and it has about 1,700 rivers and streams that total nearly 12,000 miles in length.

Florida's coastline is about 11,000 miles long, much of which is comprised of high energy beaches. Florida's barrier islands provide a wide range of recreational opportunities including fishing, swimming, hunting, camping, and nature study, located in areas such as parks, wildlife refuges, and national seashores. Barrier islands have numerous motels, restaurants, gift shops, amusement parks, marinas, golf courses, tennis courts, and swimming pools. Florida has 13 registered historic places and 7 national natural landmarks located on its barrier islands.

Florida has 173 (more or less, depending on how they are classified) recreation sites. This includes 30 preserves, forests, and State parks (Figure 2), 35 State aquatic preserves (Figure 3), 48 State wildlife management areas (Figure 4), and 32 special feature sites, 17 preserves, 7 museums, and 4 ornamental gardens (Florida Department of Natural Resources 1981).

The per capita expenditures of U.S. residents for hunting and fishing for 1955, 1960, and 1970 is shown in Table 1. These data will be used later in this report to help estimate the magnitude and value of the fishing and hunting industries in Northwest Florida.

The Governor's office (1980) has developed a set of goals and priorities for 1981-83. Those relating to outdoor recreation are as follows:

> Goal: to improve outdoor recreation opportunities through development and implementation of a new outdoor recreation plan.
>
> Policies: (1) The State shall continue acquisition and development of State parks with emphasis on high quality resources and public accessibility. (2) The State shall provide recreation programs, sites, and facilities that best meet public demand. (3) The State shall expand recreational opportunities to include user-oriented recreation, particularly in and around urban areas to provide convenient and energy conservative outdoor recreation. (4) The State shall emphasize inter-agency coordination and cooperation in providing improved and diversified outdoor recreation opportunities.

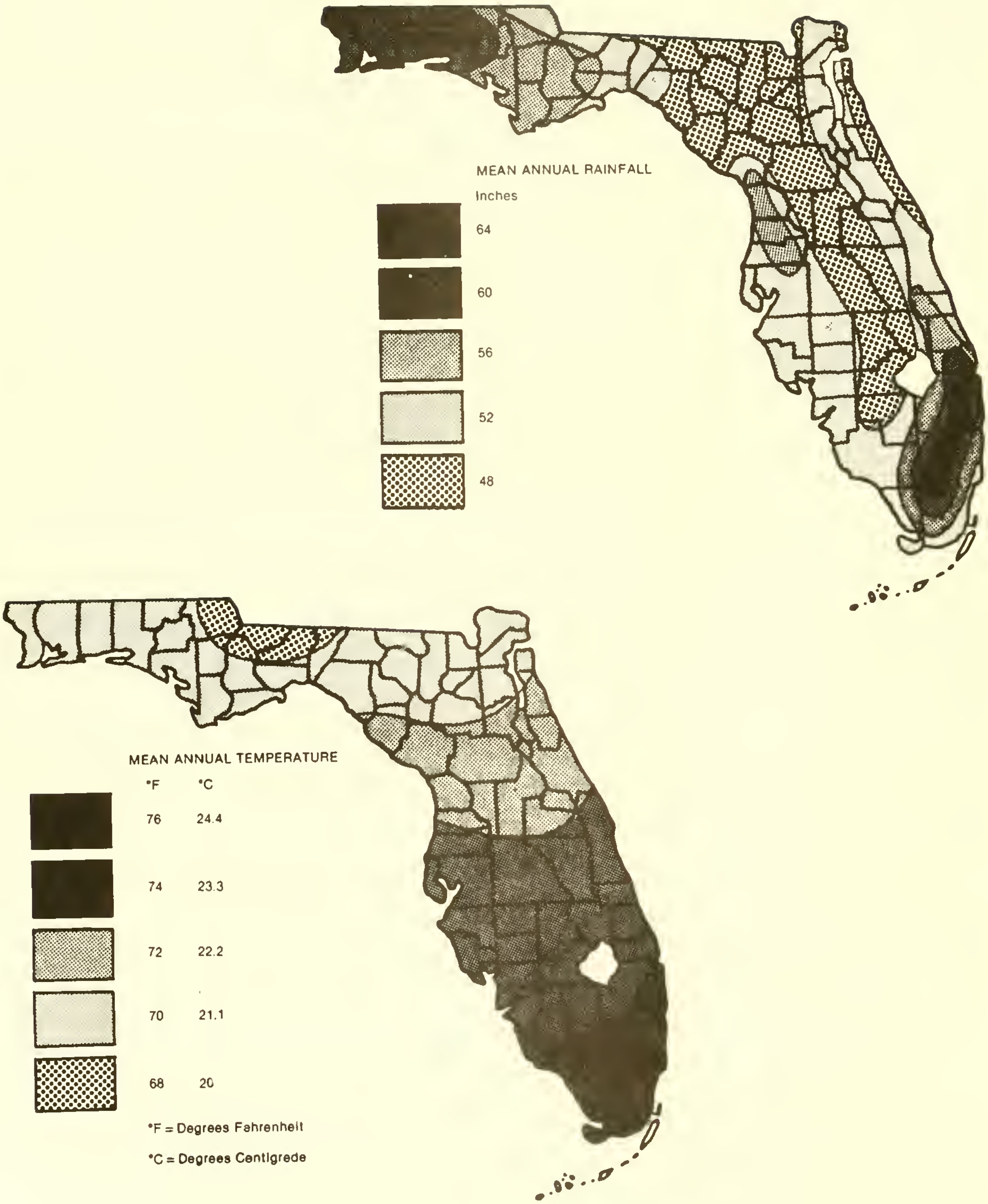

Figure 1. Mean annual rainfall and temperature in Florida (Wood and Fernald 1974).

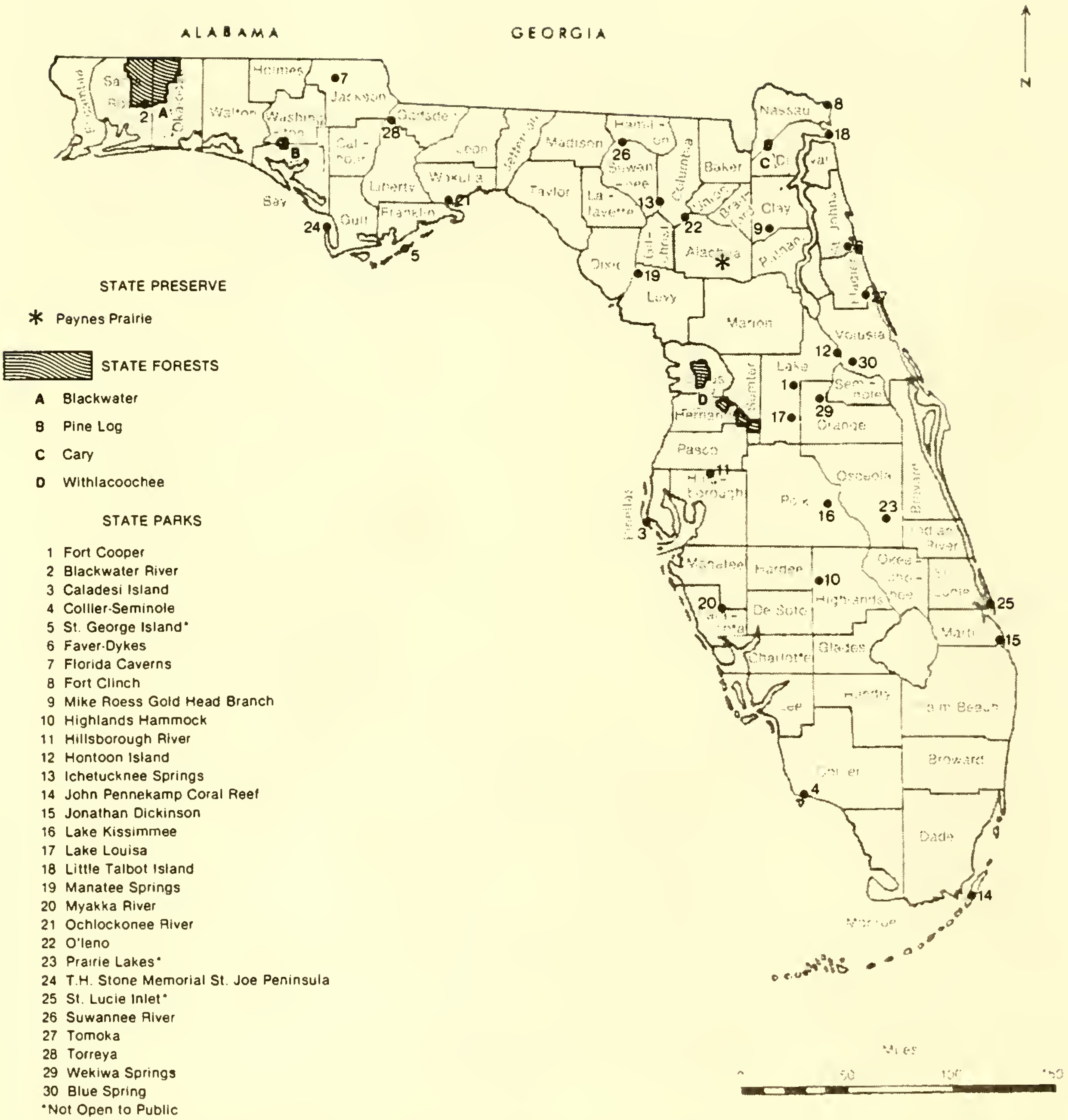

Figure 2. State preserves, forests, and parks (Florida Power and Light Co. 1979).

Figure 3. State aquatic preserves (Florida Power and Light Co. 1979).

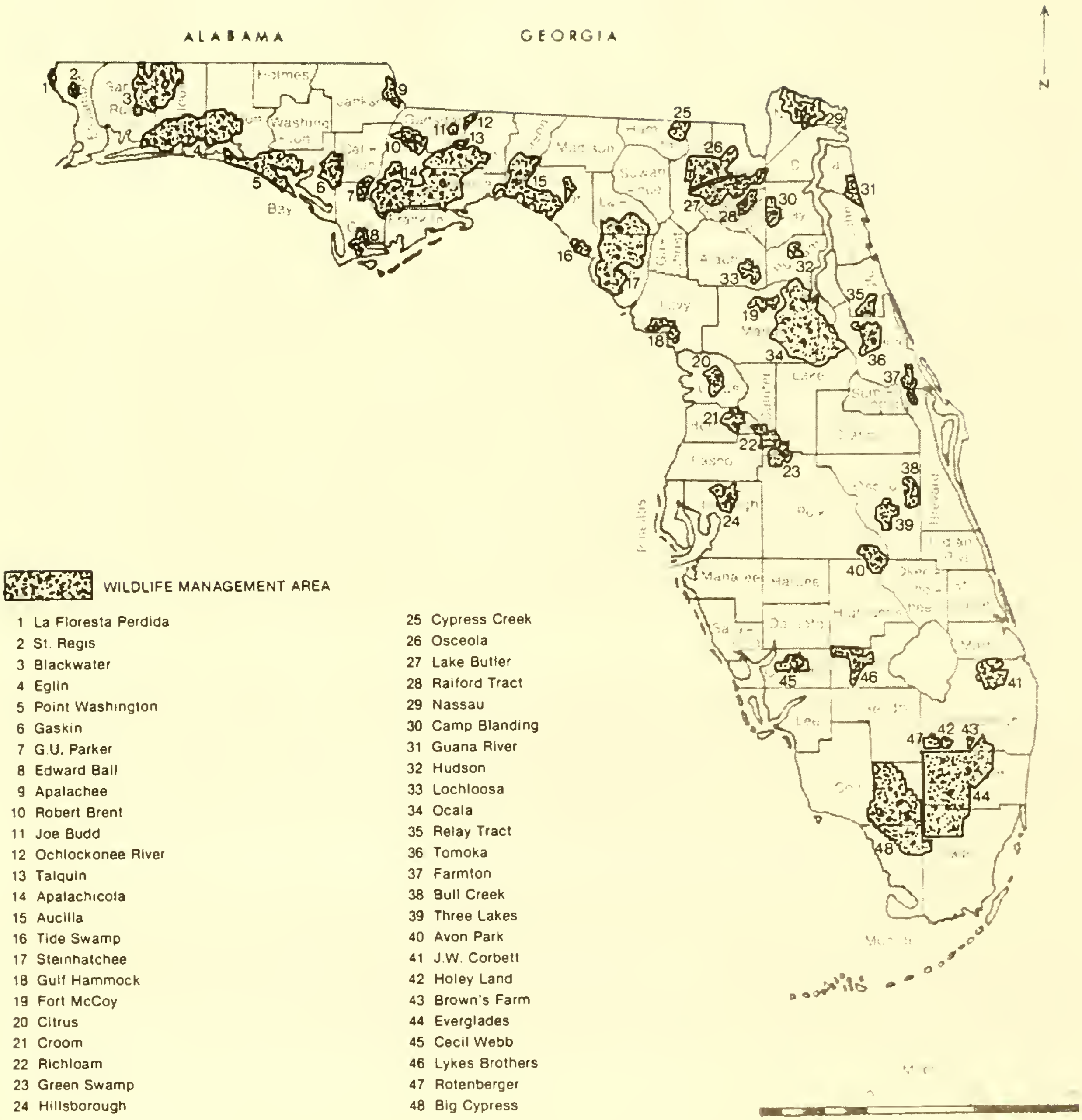

Figure 4. State wildlife management areas (Florida Power and Light Co. 1979).

Table 1. Per capita expenditures (in dollars) in the United States for fishing and hunting (Adapted from U.S. Department of Interior, Fish and Wildlife Service 1960, 1970).

Category	1955	1960	1970
Freshwater fishing	77	$ 95	$127.17
Saltwater fishing	91	101	178.10[a]
Waterfoul hunting	60	46	84.47
Small game hunting	50	60	81.02
Big game hunting	73	55	122.53

[a]Gulf of Mexico only.

STATE PROGRAMS

The Florida Department of Natural Resources (DNR), Division of Recreation and Parks has the authority to acquire, develop, and operate State parks and recreation areas. The Division is responsible for administering a comprehensive recreation program. State funds from the Land and Water Conservation Funds are matched by Federal funds to purchase parks and recreation sites. The Division develops a State Outdoor Recreation Plan every 5 years and provides technical assistance on outdoor recreation to local governments through the Florida Recreation Development Assistance Program. The Florida DNR spent $483.85 million on parks and recreation in fiscal years 1971-72 through 1979-80 and increased the number of employees in park and recreation programs from 424 to 767 (Governor's Office of Planning and Budgeting 1981). The DNR Division of State Lands administers the Conservation and Recreation Lands (CARL) program designed to purchase environmentally endangered lands and recreation areas.

The Florida Game and Fresh Water Fish Commission (GFWFC), which manages freshwater fish and wildlife spent $16.99 million on freshwater fish programs and $13.63 million on wildlife programs in fiscal years 1976-77 to 1979-80. The number of employees in the freshwater fishery program increased from 154 to 175, and in the wildlife program it increased from 71 to 111 (Governor's Office of Planning and Budgeting 1981).

The Florida Department of Commerce promotes tourism by advertising and by surveying tourists. The Department of Commerce spent $1.68 million for tourism programs in fiscal year 1972-73 to 1973-74 with plans to spend $5.5 million in fiscal year 1980-81. The number of employees in this department that worked in various tourism related programs increased from 66 to 112 (Governor's Office of Planning and Budgeting 1981).

FEDERAL PROGRAMS

The U.S. Department of Interior (DOI) is the agency with primary responsibility for national parks and recreation related programs. Within the Department, the National Park Service (NPS) uses Land and Water Conservation Funds for purchasing parks and recreation sites. The NPS also evaluates and designates natural historic and cultural sites that qualify for the National Registry of Natural Landmarks and National Register of Historic Places. The Service also manages an historic preservation fund that provides matching funds to the states. Since 1965, the State has acquired 73,023 acres of recreation areas from funds from the NPS, as well as the designation of six national trails. The National Register of Historic Places in 1980 listed 347 sites. In addition, there were 19 NPS registered historic landmarks in Florida in 1980.

The National Park Service manages national parks and recreation areas, national seashores, and other natural areas. It also designates national environmental studies for these areas in cooperation with educational institutions. Ten of these areas, comprising over 1.6 million acres of land, are in Florida. The U.S. Fish and Wildlife Service manages 24 national wildlife refuges and wilderness areas in Florida that total over 451,000 acres. The Bureau of Land Management (Minerals Management Services) manages national lands including offshore bottoms beyond Florida's territorial waters. The U.S. Forest Service manages four national forests in Florida that cover about 1.3 million acres of land and contain 59 developed public recreation sites that total 1,313 acres. The U.S. Army Corps of Engineers, in conjunction with flood control and water management projects, developed 13 recreation areas of 775 acres. The U.S. Department of Defense allows public hunting within wildlife management areas on certain Air Force facilities in Florida. The U.S. Department of Agriculture and the U.S. Department of Interior jointly manage 11 designated wilderness areas consisting of 1,379,612 acres in Florida (Florida Department of Natural Resources 1981). The location of national parks and recreation areas in Florida are shown in Figure 5.

OUTDOOR RECREATION IN FLORIDA

Most of the data and information in this report were gathered from national surveys of fishing and hunting, marine recreational surveys, and surveys taken by the Florida DNR for their five-year outdoor recreation plan.

The statewide outdoor recreation demand per capita, including residents and tourists for 1970, 1975, and 1980, is given in Table 2 and participation in various outdoor forms of recreation in 1980 are given in Table 3.

According to data in Outdoor Recreation in Florida (1976), nearly 300 million man days of outdoor recreation (27% of the statewide total) were generated by Florida tourists in 1975. Bike riding and beach recreation account for about 50% of the total man days of recreation. Nearly 50% of the State's residents and 67% of the tourists participated at least once in beach recreation.

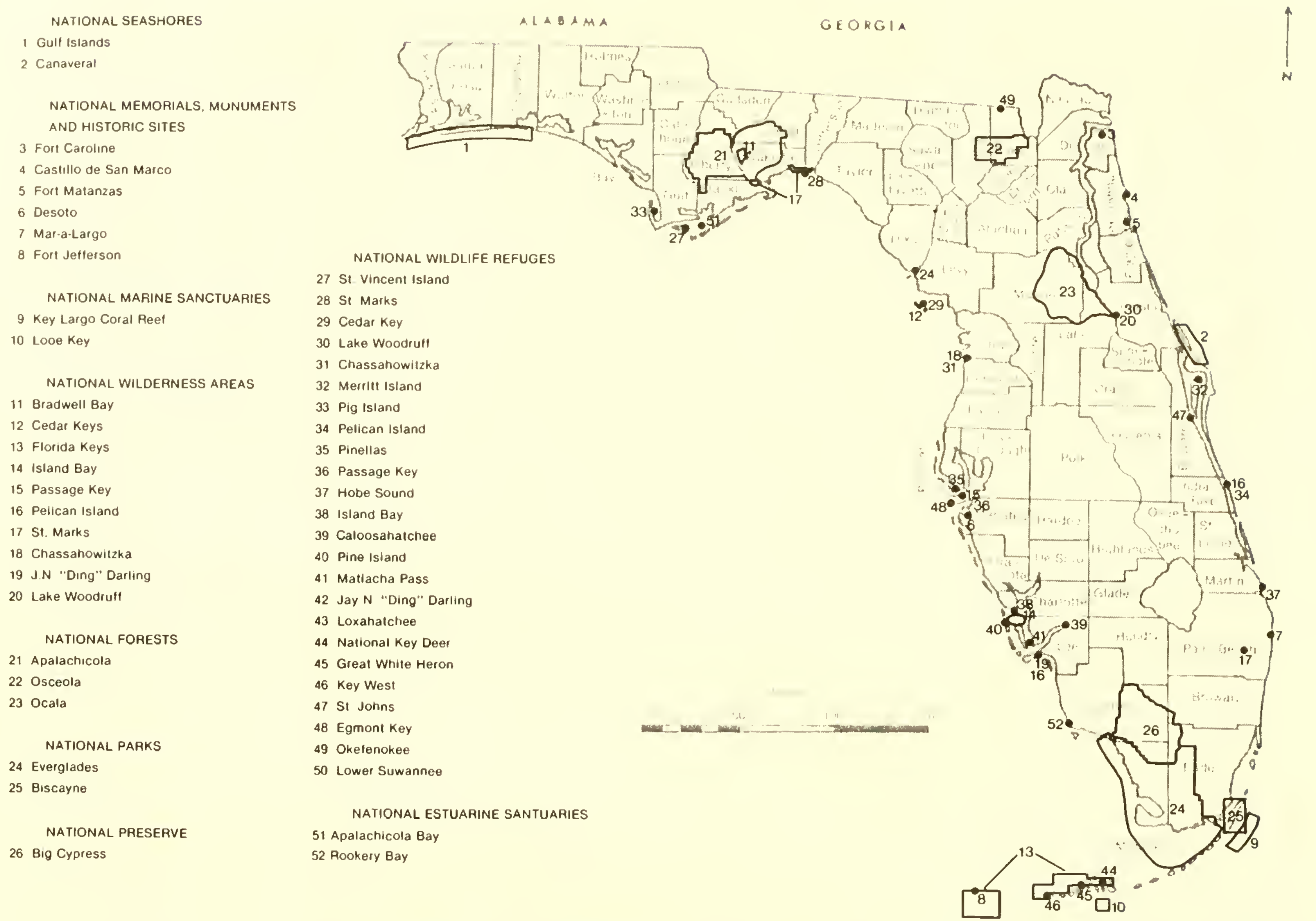

Figure 5. National seashores, memorials, monuments, historic sites, marine sanctuaries, estuarine sanctuaries, wilderness areas, forests, parks, wildlife refuges, and preserves (Florida Power and Light Co. 1979).

Table 2. Per capita participation (average man days of recreation per person per year) in outdoor recreation in Florida in 1970, 1975, and 1980 (Florida Department of Natural Resources 1971, 1976, 1981).

Type of recreation	1970 Resident (Adult)	1970 Resident (Child)	1970 Tourist (Air)	1970 Tourist (Auto)	1975 Resident	1975 Tourist	1980 Resident	1980 Tourist
Saltwater beach	11.8	15.0	2.9	5.0	17.4	4.5	2.4	2.1
Swimming pool	--	--	--	--	--	--	1.5	1.4
Bike riding	9.9	64.2	0.1	0.2	32.0	0.4	2.6	0.5
Recreational vehicle camping	0.3	0.2	< 0.1	1.9	0.5	0.7	0.2	0.9
Tent camping	0.1	0.3	<0.1	<0.1	0.6	0.4	0.2	<0.1
Historical and archaeological sites	0.7	2.0	0.3	0.8	0.7	0.6	0.3	0.3
Freshwater swimming[a]	10.2	26.4	1.1	1.2	3.6	0.9	1.0	0.1
Saltwater fishing (nonboat)	2.1	1.30[b]	0.1[b]	0.3	6.6[c]	0.8[c]	0.6	0.2
Saltwater fishing (boat)	1.5	2.3[d]	0.3[d]	0.4	--	--	0.6	0.1
Freshwater fishing (boat)	1.6	1.9[e]	0.1[e]	0.2	5.4[f]	0.5[f]	0.7	0.1

(continued)

Table 2. (Concluded).

Type of recreation	1970 Resident (Adult)	1970 Resident (Child)	1970 Tourist (Air)	1970 Tourist (Auto)	1975 Resident	1975 Tourist	1980 Resident	1980 Tourist
Freshwater fishing (nonboat)	2.8	2.5	0.1	0.2	--	--	0.6	0.1
Hiking	3.9	4.3	0.2	0.7	1.8	0.3	0.5	0.2
Nature study	4.6	5.9	0.2	0.3	3.7	0.3	0.4	0.2
Hunting	0.4[g] 0.8[i] 0.2[j]	0.2[g] 0.7[i] 0.2[j]	-- -- < 0.1	-- 0.02 --	1.07[h]	0.25[h]	0.85[h]	0.85[h]
Canoeing	0.1	0.3	< 0.05	0.05	0.5	0.1	0.2	<0.05

[a]Includes swimming pool.
[b]Surf fishing only.
[c]Includes all saltwater fishing.
[d]Fishing from boat ramp only.
[e]Fishing within lakes only.
[f]Includes all freshwater fishing.
[g]Big game.
[h]Includes all hunting.
[i]Small game.
[j]Waterfowl.

Table 3. Types of outdoor recreation and available daily supply for participating individuals in Florida in 1980 (Florida Department of Natural Resources 1981).

Type or area of recreation	Available supply
Freshwater and saltwater swimming (nonpool)	2.5 linear ft of beach
Saltwater beach	100 ft^2 of beach
Boat ramp: fishing, powerboating, water skiing and sailing	160 users per single land ramp/day
Freshwater and·saltwater fishing (nonboat)	6 linear ft of docking
Historical and archaeological sites	384 users per site/day
Hiking	1 mi of trail per 125
Nature study	1 mi of trail per 250
Bicycling	1 mi of trail per 161
Hunting	21 acres

According to a study of outdoor recreation in Florida in 1981, over 400 million man days of recreation (64% of total demand) were generated by tourists. Beach and outdoor swimming pool recreation accounted for about 40% of the total demand for outdoor recreation, and nearly 75% of all residents and 80% of the tourists went to the beach at least once in 1980. The demand by tourists was greater than that of residents for saltwater beaches, swimming pools, camping, picnicking, visiting historical and archaeological sites, freshwater swimming (nonpool), saltwater fishing (nonboat), hiking, nature study, and golfing. Since 1970, bike riding and saltwater beach activities characterized the recreation of residents, whereas tourists tended to engage more in recreational vehicle camping, and freshwater pool swimming (Table 2). Residents were least active in tent camping and canoeing whereas tourists were least active in hunting.

SPORT FISHING

The 1970 U.S. Fish and Wildlife Service's National Survey of Fishing and Hunting provides expenditure and participation data on sport fishing for the Southeastern United States. The survey showed that in 1970 about 17% of the population fished in fresh water and 11% fished in saltwater (including those that fished in both). Most fishermen were in the $10,000 to $15,000 family income bracket. The percentage of people in the Southeastern United States that fished was about 20% in 1955, 21% in 1960, 24% in 1965, and 22% in 1970.

About 2.38 million people from 1.07 million households fished for saltwater sport fish and shellfish in 1974 (U.S. Department of Commerce 1977). About 2.1 million fishermen from 954,000 households sought sport fish and

989,000 sport fishermen from 419,000 households sought shellfish (includes those who fished for both). In all there were 24.68 million man days (trips) of finfishing and 8.0 million days of shellfishing. The average sport fisherman fished about 12 days a year for finfish and 8 days for shellfish.

The 1975 National Survey of Hunting, Fishing and Wildlife and Associated Recreation included statistics for Florida. In 1975 about 1.7 million sport fishermen fished in marine and brackish waters and 693,000 fished in rivers and freshwater lakes. In Florida in 1975, fishing expenditures were about $770.8 million. Major expenditures were as follows: $166.0 million for fishing supplies and equipment, $171.7 million for food, drink, and refreshments, $219.1 million for transportation, and $86.6 million for bait. Largemouth bass and other basses were the favored freshwater fish. The 1975 fishing cost for the 426,000 bass fishermen was about $41.8 million. An estimated 377,000 big game fishermen in boats offshore (many chartered) spent $114.42 million, whereas the 285,000 nearshore and estuarine fishermen in boats spent $46.22 million. The 1975 survey reports that the average fisherman spent $324.26 a year to fish. Individual costs were $98.15 for bass fishing, $303.51 for offshore big game fishing, and $162.17 for boat fishing.

The Fishery Conservation and Management Act of 1976 expressed Congressional concern for sport fishing. In the act, the definition of optimum sustained yield (OSY) includes sport fishing. At a minimum, the following data for any one year are needed for managing sport fisheries according to OSY guidelines: number of fishermen, average annual number of fishing days per fishermen, and the average catch per trip. Other helpful data that might be collected are: distance traveled to fish, average cost per trip, the number of trips, socioeconomic information on fishermen and their communities, and population statistics. The major problem concerning sport fishing in the Southeastern United States is the serious lack of data on catch and fishing effort.

The rise in total real expenditures and the number of days fished annually in recent decades probably is due primarily to the increased number of fishermen (Bell 1978), which may have caused a decrease in catch per unit of effort. According to Bell (1979), over $851 million in gross expenditures were spent by residents and tourists in 1975 for saltwater sport fishing in Florida (Table 4), which is about 15% of all taxable sales on recreation in the State.

The saltwater sport fishery of Florida in 1976 supported about 44 million fishing days annually (Table 4) at a cost of about $9.00 per fisherman. About one-third of the fishermen were tourists, a statistic used for estimating that there were 14.6 million tourist days of fishing in 1975. The expenditure per man day of fishing probably is the same for tourists and residents alike. The average daily expenditure for tourists was $31.47 in 1975 (Bell 1979). Using Florida Department of Commerce information on tourist expenditures, Bell estimated that the saltwater sport fishery for tourists in 1975 created $111 million in wages and salaries in the export sector and added $464 million to the nonbase sector. Based on National Marine Fisheries Service (NMFS) estimates of retail jobs associated with sport fishing, saltwater fishing generated 34,700 jobs. Furthermore, the multiplier effect of the $464 million adds another 83,739 jobs. In all, the saltwater sport fishery supported over 118,000 job in Florida. The average saltwater sport fishermen spent about

$19.75 a day. When multiplied by the number of tourist and resident fishing days, and applying a capitalization rate, the total value of saltwater sport fishing in Florida in 1975 was $18.7 billion.

Table 4. Gross expenditures and user values (both in millions of dollars) of the saltwater sport fishery in Florida in 1975 and the number of fishermen and fishing days (both in millions) according to Bell (1979).

Type of fishermen	Gross expenditure by fishermen	User value	Number of fishing days (millions)	Number of fishermen
Resident	$392[a]	$ 872[b]	44	1.64
Tourist	$459[c]	$ 288	15	0.54
Both	$851	$1,160	59	2.18

[a]$408.39 x 0.96. (in-state participation).
[b]Number of days fishing x individual expenditures of $19.75 per day.
[c]Number of tourist fishing days x individual expenditure of $31.47 per day.

Bell (1978) also made the same calculation for freshwater sport fishing (Table 5). He stated that:

- $526 million, in gross expenditures, is spent annually by residents and tourists on freshwater sports fishing or about 9% of all taxable sales on recreation in the state.
- Gross expenditures per day for freshwater fishing was $4.78 or 54% of daily expenditures on saltwater fishing.
- Tourist expenditures for freshwater fishing are estimated at $278 million.
- Freshwater recreational fishing by tourists creates around $70 million in wages and salaries in the export sector and an additional $293 million in the nonbase sector.
- All expenditures for freshwater recreational fishing generate about 21,775 jobs and applying the multiplier effect yields an overall total of 75,000 jobs generated by freshwater fishing.
- Capitalizing the user value of freshwater fishing yields an overall user value of $8.4 billion. (User value per day is $7.67).

Table 5. Gross expenditures and user values (both in million of dollars) of the freshwater sport fishery in Florida in 1975 and the number of fishermen and days of fishing (both in millions) accord to Bell (1979).

Type of fishermen	Gross expenditure by fishermen	User value	Number of fishing days (millions)	Number of fishermen
Resident	\$247.56[a]	\$397.24[b]	51.9	1.44
Tourist	\$278.23[c]	\$ 96.13[c]	12.5[c]	0.35
Both	\$525.79	\$493.37	64.4	1.79

[a] \$272.135 million x 0.91 (in-state participation).
[b] Number of days of fishing x median user value per day (\$7.67).
[c] Number of tourist fishing days x individual expenditure of \$22.20 per day.

HUNTING

In 1970 about 3.5% of the population in the Southeastern United States hunted big game, 7.4% hunted small game, and 1.3% hunted waterfowl. About 25% of the hunters used public lands for hunting at one time or another. The percentage of the population in the Southeastern United States that hunted was 10.1% in 1955, 11.5% in 1960, 9.2% in 1965, and 8.1% in 1970 (U.S. Department of Interior 1970).

In Florida in 1975 the 493,000 hunting licenses sold generated 10.53 million man days of hunting. Of this total, 330,000 hunted big game (3.48 million man days), 302,000 hunted for small game (4.0 million man days), 317,000 hunted for migratory birds (2.35 million man days), and 78,000 hunted for other birds and animals (652,000 man days). Of the hunters, 321,000 hunted deer (2.8 million man days) and 79,000 hunted wild turkey (454,000 man days). The hunters spent \$103.1 million for big game, \$54.3 million for small game, \$30.4 million for waterfowl, and \$1.9 million for other animals for a total of \$196.6 million. In 1975, each hunter in Florida spent about \$398.84 for hunting. Most of the expenses were for equipment, supplies, and transportation.

The U.S. Fish and Wildlife Service, in a press release in 1981, reported that 253,619 people in Florida spend nearly \$3.7 million for hunting licenses.

NORTHWEST FLORIDA OVERVIEW

FACTORS AFFECTING RECREATION AND TOURISM

Climate

Climate is closely linked with recreation and tourism in Northwest Florida. The average summer temperature is near 81°F and average winter

temperatures are in the low 50's (°F). Rainfall is relatively heavy, ranging from 58 inches to 66 inches among the counties. More detail on climate is given in Table R/T 7 in the Data Appendix.

Living Resources

The abundance of living resources is the key to recreation and tourism in Northwest Florida (Ketchum 1972). Recreation often includes fishing, hunting, and nature study, all totally dependent on living resources. Good coastal management will try to maintain an abundance of living forms. Pollution probably is the greatest threat to living resources.

Mammals, birds, and fish are the major living resources. The marine mammals of the Gulf of Mexico consist largely of whales, dolphins, porpoises, seals, sea lions, and manatees (described in a publication by the State University System of Florida's Institute for Oceanography 1973). Manatees receive the most interest, partly because they are often seen in shallow coastal waters and partly because they are an endangered species. They are threatened by habitat deterioration and power boats (mostly propeller injury). The humpback and sperm whales have been seen in the gulf waters of Southwest Florida. Some of the major coastal birds are horned grebe, common loon, cormorant, the Louisiana and great blue heron, common and snowy egret, various waterfowl (such as the Canada goose and pintail) bald eagle, sandpipers, terns, and gulls.

The major sport fishes in the Gulf are spotted seatrout, red drum, king and Spanish mackerel, mullet, and bluefish. Major shellfishes are blue crabs, scallops, clams, and oysters. Offshore favorites are marlin, swordfish, albacore, bonito, tuna, and dolphin. A bait shrimp and bait fish industry is a sizable offshoot of the sport fishery.

Barrier Islands

The barrier islands are one of the most important physical resources for residents and tourists in Northwest Florida. According to the U.S. Department of Interior (1979), the major islands of Northwest Florida and the percentage of area developed for human use are St. Andrews (88%), Miramar (23%), Santa Rosa Island (25%), and St. George (8%). The barrier islands that are protected by Federal, State, or local ownership are Cape San Blas, Crooked Island, Shell Island, St. George Island, Little St. George Island, Dog Island, St. Vincent Island, and Santa Rosa Island.

Population Characteristics

Some of the major characteristics and socioeconomic and natural factors that affect recreation and tourism in Northwest Florida are discussed in the following paragraphs. Major socioeconomic factors are population, population distribution and density, income, and housing demand.

From 1960 to 1980 the population of Northwest Florida increased from 364,000 to 537,000 (47%). The greatest increases were in Santa Rosa and Okaloosa Counties. Since about 1950, the increase in leisure time and higher standards of living have been largely responsible for the increase in the number of seasonal or second homes. In 1972, there were over 5,000 second homes along the Florida gulf coast.

Age is a factor affecting preferred recreation. Young people prefer canoeing, hiking, and camping, whereas older people tended to prefer more passive forms such as golf and nature study (e.g., bird watching). People with higher incomes prefer beach recreation, often using recreational vehicles, but people of low income are dependent upon low cost or free recreation such as neighborhood playgrounds.

Natural constraints on the use of recreational areas are limitations in space (overcrowding), access, and availability. Climate also is a factor (Ketchum 1972). Beach recreation and swimming require warm safe waters. Boaters are more affected by bad weather and the availability of marinas and boat launching facilities. Availability and access are important factors because people with low income do not usually travel far for recreation.

CHARACTERISTICS OF TOURISM

Travel expenditures, population growth, and employment serve as indices for evaluating the tourist industry. Examples are food service, employment, lodging, and transportation-related jobs.

Tourism in Northwest Florida has increased sharply since the mid-1960's. The number of tourists in 1965-79 increased nearly 300% (1,110,000 to 4,409,000). Numbers increased as high as 510% in Okaloosa County and as low as 244% in Escambia County. Since there are no county statistics for tourist trade expenditures and length of stay, statewide statistics are used for estimates of the value of tourism in Northwest Florida. In 1969 the average tourist in Florida spent $159.00, which, if multiplied by the number of tourists in Northwest Florida, gives a $176 million industry. By 1980, tourist expenditures in Northwest Florida increased to one billion dollars, a net gain of $830 million (470%). Tourist expenditures vary somewhat. For example, money spent per tourist was $159 in 1965, $346 in 1976, and $288 in 1980.

Indicators of the level of tourism are the number and capacity of restaurants, hotels, motels, motor courts, rooming houses, and apartments. Data extracted from the annual statistical reporting units from the Florida Hotel and Restaurant Commission show that in 1955-80, the number of restaurants in Northwest Florida increased 38% (797 to 1,100) and seating capacity increased 109% (37,529 to 78,571). Although the number of lodging places increased 110% (944 to 1,978), and the number of units increased 112% (15,527 to 32,987), the number of lodging places and units in Gulf County decreased despite a 221% increase in the number of tourists.

The percentage increase in the number of restaurants from 1955 to 1980 was 144% (102 to 249) in Okaloosa County and 62% (200 to 323) in Bay County. The percentage increase in seating capacities was 168% (9,049 to 24,209) in Bay County and 253% (5,067 to 17,869) in Okaloosa County. An increase of 303 restaurants and 44,222 seating units was reported for 1955 to 1980.

Okaloosa, Bay, and Santa Rosa Counties had the greatest increase in the number of lodging sites, whereas Okaloosa and Escambia Counties had the greatest increase in lodging units. For Northwest Florida the number of lodging units per lodge remained constant in 1955 to 1980 (16.5-16.7). The number of

lodging sites and lodging units in Gulf County and Franklin County decreased. Franklin County lost 50% (651 to 324) of its lodging units in 1955-80.

The other indicator of tourism is the number of employees in hotel/motel and other lodging business establishments, and in eating and drinking places. As determined from Tables EMP 13-16 in the Data Appendix, regional employment in lodging businesses has increased nearly 209% (1,080 to 3,347) since 1956. In Northwest Florida in 1978, there were 76 employees per 100,000 tourists in hotel/motel and other lodging places. The highest was 98 employees per 100,000 tourists in Okaloosa County. The number of employees in eating and drinking establishments in Okaloosa County increased 605% (279 to 1,966) and nearly 470% (65 to 370) in Santa Rosa County.

According to unpublished data provided by Mr. Ed Stalvey of the Florida Department of Revenue, the State of Florida collected over $83 million in sales taxes from all counties in Northwest Florida in fiscal year 1978-79.

Those counties with the most taxes were Escambia, Bay, and Okaloosa Counties, which accounted for 90% of all sales tax collections among the seven counties. The 1,893% increase ($4.16 million to $82.92 million from 1955/56 to 1978/79) in sales tax receipts among the counties is probably due to the sharp increase in the resident population and tourists in those years. In Northwest Florida, sales capita per resident was $22.99 in 1960 and $154.50 in 1979. If tourists were counted as residents, sales per capita would drop considerably.

OUTDOOR RECREATION IN NORTHWEST FLORIDA

HIGHLIGHTS

Changes or stress in outdoor recreation will be in those that are resource-based (e.g. hunting and fishing) rather than user-oriented (e.g. golf and tennis). Resource-based recreation includes beach activities, boating, camping, biking, fishing, hiking, hunting, horseback riding, nature study, surfing, swimming, and water skiing. Beach activities include sunbathing, beach combing, and shell collecting. Boating includes fishing, cruising, sailing, and canoeing. Northwest Florida has an ample supply of marinas, docks, boat ramps, and other facilities necessary for boating.

Good fishing is indicated by the many fish camps, bridges, marinas, party and charter boat facilities, fishing guides, and catwalks. Hunting is the most environmentally demanding of all outdoor recreation because it requires much land, an abundance of game, and high quality environment. In the forest, uplands, and wetlands, most hunting is done with a rifle, but bow and arrow hunting is becoming popular. Game species are turkey, squirrel, deer, wild boar, quail, dove, rabbits, and various waterfowl such as ducks, geese, and coots.

Expenditures by State and local (primarily county) governments for recreation are valuable indicators of supply and demand. Local government expenditures for recreation were examined from the County Finances and County Fee Officer's Reports for the years 1950, 1955, 1960, 1965 and from the Local

Government Financial Reports of the State Comptroller for fiscal years 1972/73, 1975/76, and 1978/79. From 1955 to 1979 local government expenditures for recreation in Northwest Florida increased about 1,195% ($5.732 million to $6.9 million). Greatest expenditures were in Escambia and Bay Counties. In 1978-79, local governments spent $12.77 per person for recreation. The highest was $18.92 for Santa Rosa County.

For all of Florida in 1971-80, the Department of Natural Resources spent $283.85 million on parks and recreation programs. The average annual increase was $4 million. In the same years, the numbers employed in parks and recreation increased from 424 to 765. From 1976 to 1981, the Florida Game and Freshwater Fish Commission spent nearly $17 million annually on freshwater fishery programs and about $13.6 million on wildlife programs. Expenditures for freshwater fisheries increased about $114,000 per year whereas wildlife expenditures increased about $312,000 per year. Employment in these programs also increased.

OUTDOOR RESOURCES

Florida is one of the most highly developed recreational areas in the United States. Common are state parks, aquatic preserves, recreational areas, parks, forests, wildlife refuges, historical and archaeological sites, game preserves, and public beaches. A list of State parks and recreation areas in Northwest Florida is given in Table 6. The State also manages scenic and wild rivers, canoe trails, environmentally endangered lands, and fish management areas.

Table 6. State parks and recreation areas in Northwest Florida (Florida Department of Natural Resources, Division of Recreation and Parks 1981).

County	Recreation area
Bay	Saint Andrews State Park
Escambia	Big Lagoon, Fort Pickens
Franklin	Fort Gadsden, Saint George Island, John Gorrie Museum
Gulf	Dead Lakes, Saint Joseph State Park, Constitution Convention
Okaloosa	Rocky Bayou
Santa Rosa	Blackwater River
Walton	Basin Bayou, Grayton Beach, Ponce DeLeon Springs, Eden Gardens

The Blackwater River in Santa Rosa and Okaloosa Counties is under study by the State for designation as a scenic and wild river. State designated canoe trails are the Perdido River (Escambia County), Coldwater Creek (Santa Rosa), Blackwater River (Okaloosa), Yellow River (Okaloosa), and Econifina

Creek (Bay). State environmentally endangered lands in the region are Perdido Key in Escambia county, and Lower Apalachicola, Little St. George Island, and St. George Island State Park (Franklin County).

For fishing, the Florida Game and Freshwater Fish Commission manages Lake Stone (Escambia County), Bear Lake (Santa Rosa), Hurricane Lake, Karich Lake (Okaloosa), and Juniper Lake (Walton). St. Vincent Island and Shell Island are national landmarks. The counties primarily supply a combination of resource-based and user-oriented areas such as beaches, swimming areas, and boat ramps. Typical city-owned recreational areas are playgrounds, swimming pools, ball fields, golf courses, and tennis courts.

In 1980, public lands contributed more recreation areas (1.63 million acres) than the private sector (8,745 acres) and more beach frontage (423,750 ft compared to 4,030 ft). Okaloosa County contributed 43.1% of the public recreation area and Escambia County contributed the most public beach frontage (40.9% of 173,180 ft) followed by Franklin County (36.5%).

In 1980, privately owned recreational facilities in Northwest Florida consisted of 9,187 acres of hunting area, 236 boat ramps, piers, and marinas, and 4,030 ft of saltwater beach frontage (Table R/T 20 in the Data Appendix). Santa Rosa County had the most (87%) private hunting areas and 90.6% of the privately owned beach frontage. Escambia County had 32.4% (2,832 acres) of all private recreational area.

Public recreation areas are owned or managed either by Federal, State, county, or municipal agencies. The total Federal recreation area in Northwest Florida was 522,287 acres including 4,267 acres of hunting area and 44 miles of saltwater beach frontage. Okaloosa County had the greatest portion of all Federal recreation areas. All hunting acreage was in Franklin and Okaloosa Counties. Escambia County has 70% (31 miles) of the federally owned saltwater beaches and the St. Vincent National Wildlife Refuge, which has 12,490 acres of hunting land and 8.8 miles of beach.

State owned recreation areas in Northwest Florida total 1,105,256 acres or 67.8% of all public recreation areas. About 21% (237,400 acres) is in Okaloosa County, The State also owns 629,631 acres (98.6%) of all public hunting areas. Walton County contributes 25.7% of the State hunting areas and Franklin County contributes 53.3% (30.1 miles) of all State owned saltwater beach frontage.

County and municipal (local) resource-based outdoor recreation areas consist of beach frontage, boat ramps, piers, and marinas. Local governments own 1,950 acres of the recreation lands. About 36% of it is in Escambia County and 26% in Okaloosa County. Local governments also provide 80 boat ramps, piers, and marinas of which 18 are in Bay County. Local governments own 6.0 miles of saltwater beach frontage. About 30% of it is in Escambia County and 24% is in Santa Rosa County.

Northwest Florida has 1,079 historical and archaeological sites. Most (335) are in Franklin County and 225 are in Escambia County. Listed in Northwest Florida in 1975 were 172 historical and archaeological sites, 11,826 acres of wildlife refuges, and 667,811 acres of forestry and game management areas.

OUTDOOR RECREATION DEMAND

Yearly summaries of the visitors to various State parks in Northwest Florida were prepared by the Division of Recreation and Parks and its predecessors. The number of visitors to State parks and recreation areas increased 20.1% from 1955 to 1980. From 1972 to 1976 the number of visitors to State parks decreased 55.3% probably because of increased transportation costs. Of the 858,036 visitors to State parks and recreation areas in 1980, about 550,000 were reported for St. Andrews State Park in Bay County.

The U.S. Department of Interior (1979) reported annual visits to national seashores. The Gulf Islands National Seashore recorded 2,375,300 visitors in 1976, 2,925,500 in 1977, and 3,971,600 in 1978.

Sport Fishing

Data on freshwater and marine sport fishing and related economic impacts were reported by Bell (1978). Freshwater fishing licenses are issued to tourists for 14-day, 5-day, and yearly time periods (Tables R/T 32 37). The number of freshwater fishing licenses issued to tourists from 1954-80 increased from 4,930 to 9,201 (86%). In those years, the county, number, and percentage increase of licenses issued were Escambia, 199 to 932 (368%); Walton, 1,030 to 3,101 (201%); and Santa Rosa 127 to 341 (168%). The numbers in Gulf and Franklin Counties declined.

Freshwater. Licenses issued to residents for fishing statewide increased 6.2% (24,932 to 26,486) from 1954 to 1980. The largest increase was in Santa Rosa County 1,292 to 2,539 (96%) and Bay County 5,369 to 8,912 (66%). Counties showing a decrease were Gulf 5,878 to 2,398 (59%), Franklin 878 to 484 (45%), and Escambia 7,198 to 5,742 (20%). For Northwest Florida in 1960, nine licenses were issued per 100 residents, but by 1980, only five were issued per 100 residents. Estimates of tourists and resident demand for freshwater sport fishing are given in Tables R/T 8-16 in the Data Appendix. The demand for freshwater fishing is expected to increase from 749,300 to 919,500 trips (22.7%) from 1980 to 1990. The 1980 resident and tourist demand was 152 fishing trips per 1,000 people.

Saltwater. U.S. Department of Commerce (1980) provided saltwater sport fishing statistics for the gulf coast including Florida. Major saltwater sport species are sea catfish, spotted seatrout, croaker, pinfish, mullet, sand sea trout, and seabass. In the Florida gulf area, there were 9.53 million fishing trips of which 7.28 million were by coastal residents, 27,000 by noncoastal residents, and 2.23 million by tourists. The estimated number of saltwater sport fishing trips in the Florida gulf area was 2.15 million of which 1.24 million were by coastal residents, 5,000 by noncoastal residents, and 898,000 by tourists. The average number of trips per year per person was 5.9 for coastal residents, 5.4 for non-coastal residents, 2.45 for tourists, and 4.4 for all. The average fishing trip was 3.8 hours long. The average cost per trip was $10.20 and the average one-way mileage was 27.9 miles. The average angler in a year fished 16.9 hours, spent $45.29, and traveled 247.8 miles.

The Gulf of Mexico Fishery Management Council (1981), for all Gulf States, estimated that groupers, jacks, porgies, and snappers made up 93% of the number of fish caught and 99% of the weight. Annual capital expenditures

among manufacturing, wholesale, and retail trades for tackle, boats, motors, and trailers was $1.22 million in the eastern Gulf of Mexico.

Average daily catch for reef fisherman was about 26.5 lb of fish. Total catch and catch per unit of effort by sport fishermen has declined recently suggesting the possibility of overfishing in heavily fished areas. Sport fishermen are largely restricted to inshore waters because of the limited capacity of their boats to travel great distances and withstand sea conditions, and because of the long travel time. Spring, summer, and fall are the primary seasons for fishing in the Florida Panhandle. The species of greatest importance to offshore charter boats during all seasons is king mackerel. Groundfish, snapper, and grouper, are of secondary importance to charter boats.

Tables R/T 8-16 in the Data Appendix provide projected demand for saltwater sport fishing. About 2.1 million saltwater fishing trips were made in Northwest Florida in 1980; about 2.2 million is expected in 1985 and 2.5 million in 1990, an increase of 22.1% over the decade. Bay County will contribute the greatest portion of all demand for future saltwater fishing in the region. From 1980 to 1990, those counties showing the greatest percentage increase in saltwater fishing demand are expected to be Franklin and Walton Counties. In 1980, the demand ratio for saltwater fishing was 42 fishing trips per 100 people.

Cato and Prochaska (1976) provided an economic analysis of red snapper-grouper party boat operations for the Northwest Florida gulf coast. In 1974, an average of 6,714 sports fishermen fished on each boat with costs ranging from $8.50 for half-a-day to $45 for a two-day trip. Average catch per person was 7.5 lb for red snapper, 7.3 lb for grouper, and 5.2 lb for other species. In 1974, the average annual catch per boat was 134,286 lb and the average catch per fisherman was about 20 lb. Based upon the revenue per boat of $142,529 and total costs of $111,972, the net return to the boat operator was $30,557. In 1974, 48 party boats made 322,272 trips and landed 6.5 million lb of fish. Fishermen spent over $6.7 million on party boats.

The structure and economics of fee fisheries of the Florida Gulf Coast and the Keys from Pensacola to Key West were studied by Browder et al. (1978). The study analyzed offshore charter boats, inshore/offshore charter boats for bays, offshore guide boats for back country fishing, and head boats which carry large numbers of passengers and operate on a per customer basis rather than charter. The location of the marinas for these boats are given in Table 7.

Northwest Florida has 138 offshore charter boats and 23 head boats; none are inshore/offshore boats or guide boats. King mackerel, reef fishes (snapper and grouper), redfish, and flounder are most sought after by offshore charter boats in the winter and billfish in the summer and fall. Grouper is the leading species fished by head boats. The average number of fishermen per charter boat in Northwest Florida was 7.9. The average age of the fisherman was 38 years. About 82% were from out-of-state. Head boats averaged 62.1 persons per trip; about 90% of the fishermen were from out-of-state.

According to charter boat captains, of particular concern is the decline in the abundance of fish, especially king mackerel, and the rapidly increasing cost of the fishing operations.

Table 7. Marinas for saltwater sport fishing boats (Browder et al. 1978).

Type of boat	Marinas
Offshore charter	Islamorada, Marathon, Key West, Clearwater, Fort Myers Beach, Naples, Marco Island
Inshore-offshore	Boca Grande, Naples, Marco Island, Key West
Guide-boat centers	Sanibel-Captiva, Marco Island, Everglades City, Key Largo, Islamorada, Marathon, Big Pine Key
Head boats	Key Largo, Islamorada, Marathon, Key West

Offshore charter boats had a net revenue of $7,954 per vessel. There were 126 charter boats in 1960 and 138 in 1977. The number of head boats decreased from 48 to 23 from 1960 to 1977. From 1960 to 1977, the catch per unit of effort of red snapper and king mackerel declined. The profits by offshore charter boats is limited by the length of the fishing season. Most fishing is during the tourist season (June to August).

The total value of saltwater sport fishing in Florida is $18.7 billion based on 58.7 million angler days. The estimated annual expenditure per angler day is $318.35. Since there are 2.1 million angler days per year in Northwest Florida, the annual value of saltwater sport fishing was about $664 million. Based on 118,000 jobs related to the saltwater sport fishery in Florida, the fishery supports two employees per 100 fishing days. In Northwest Florida, the saltwater fishing supports 4,172 jobs. At the current rate of growth of the fishery, the saltwater sport fishery should be worth $704.51 million in 1985 and $810.84 million in 1990. The number of fishery related jobs would increase from 4,425 in 1985 to 5,094 in 1990.

If these same data were applied to the freshwater sport fishery in Florida, each fishing day is worth $130.59, and each 10,000 fishing days contributes 12 jobs to the State (Bell 1978). As calculated from Tables R/T 8-16 in the Data Appendix, the total demand for freshwater sport fishing in Northwest Florida was 749,300 fishing trips in 1980 and is projected to 834,600 in 1985 and 919,500 in 1990. These demand figures yield a total value of $97.9 million and 899 jobs in 1980, $109.0 million and 1,002 jobs in 1985, and $120.1 million and 1,103 jobs in 1990. The projections are conservative because as demand increases and supply decreases, the cost of fishing will increase accordingly.

Hunting Demand

The most comprehensive analysis of the impact of hunting on the State of Florida, in terms of its recreational value and impact on the socioeconomic structure is provided by Gibbs (1975). The major hunting categories are small game, big game, and waterfowl. Gibbs estimated that the total value of all hunting statewide is $294 million based on 6,030,400 hunter days. He further

estimated that $402 million was the actual value of hunting to the hunter, based on the payment required to give up a day of hunting. The annual expenditures of hunting in Florida was estimated at $116.06 million.

Although the number of nonresident hunting licenses issued in a county is an indicator of tourist demand for hunting, the hunting may take place in several counties. In 1954-55, only 277 hunting licenses were issued to tourists in Northwest Florida, but by 1979-80, 1,592 licenses were issued, a five-fold increase. In 1954-55, Okaloosa, Gulf, and Walton Counties issued the most out-of-state hunting licenses, but in 1979-80 Bay, Escambia, and Okaloosa Counties issued the most licenses. In 1965, two hunting licenses were issued per 10,000 tourists, but in 1979-80 this ratio doubled. Based on the total acres of hunting area in supply, as described earlier, the total hunting area per tourist licensed for 1980 was 404 acres.

Resident statewide hunting licenses in Northwest Florida increased from 8,066 in 1954-55 to 18,968 in 1979-80, an increase of 135%. In 1954-55, Escambia County (3,111) and Bay County (2,127) issued the most resident hunting licenses. This trend continued through 1979-80. In 1960, 30 hunting licenses were issued per 1,000 residents and in 1980 this ratio increased to 35 per 1,000 residents. Based on the total area available for hunting, there were 34 acres per resident licensed hunter in 1980. When tourist and resident licenses are combined, the area of all hunters licensed in 1980 is 31 acres per hunter.

The demand for hunting by all participants in Northwest Florida was 604,200 hunting days in 1980 and is projected to 673,500 in 1985 and 743,600 in 1990, a 23.1% increase. A substantial increase in hunting demand is expected in Bay County (75,000 to 95,800 or 28%) and Okaloosa County (141,500 to 178,900 or 26%). Nearly 60% of the hunting is expected to occur in Escambia and Walton Counties. In 1980, there were 12 hunting days per 100 residents.

Based on the expenditure of $47.43 per hunting day, the 1980 value of all hunting was $28.66 million. Projections for 1985 and 1990 are $31.9 million for 1985 and $35.27 million for 1990.

Demand for Other Resource-based Outdoor Recreation

Tables R/T 8-16 in the Data Appendix provide estimates of tourist and resident demand for various resource based outdoor recreation for 1980, 1985, and 1990. The demand for recreation is projected for saltwater beaches, freshwater swimming (nonpool), camping, nature study, canoeing, boating, hiking, and bike riding.

The demand (user days) from 1980 to 1990 is expected to increase 10% for saltwater beaches, 21% for recreational vehicle camping, 22% for nature study and historical site visits, 26% for pleasure boat registration, 26% for canoeing, 22% for hiking, and 23% for bike riding.

User-oriented Outdoor Recreation

From 1980 to 1990, the demand for golfing is projected to increase 24%, the tennis participation is expected to increase 26%, and swimming (in pools) is expected to increase 22%.

POTENTIAL IMPACTS OF OCS OIL AND GAS EXPLORATION AND DEVELOPMENT

In 1974, about 60% of the public that was polled favored offshore drilling for oil in Florida in response to the energy crisis. In 1979 it was 69%. Most (60%) Floridians want to promote tourism even if the tourists reduce available supplies of gasoline. Only 25% of those polled oppose increased tourism because of a drain on the State's energy supplies (Bell et al. 1980).

A report by Havran and Collins (1980) on OCS oil and gas activities in the Gulf of Mexico and their onshore impacts is valuable for assessing potential environmental impacts on coastal Florida. Gulf of Mexico OCS production platforms in Texas and Louisiana are linked to shore by an extensive network of pipelines that transport oil and gas to nearby terminals. The production of oil and gas sometimes led to the growth of massive onshore industrial complexes that cause many environmental problems. The most severe onshore environmental impacts are apparent in frontier areas where few of the needs for onshore operations and facilities are available. Since port facilities along the Florida coastline are not geared for OCS oil and gas development, any high or moderate level oil and gas find along the Florida gulf coast could cause local economic and community upheavel.

The potential for oil pollution is a major issue raised by offshore oil drilling. Leaks from pipelines and platforms potentially could have some damaging effects on sport and commercial fishing, saltwater beach recreation, and boating. Pipeline construction may disrupt the bottom habitat and destroy benthic organisms. Even buried pipelines may threaten beaches or residential sites. In addition to terminal sites and channels, turning basins may need to be dredged or maintained for deep draft tankers. Loss or alteration of coastal lands and water would reduce recreational potentials.

A substantial work force may be required for the construction and operation of the necessary onshore facilities for OCS oil and gas development. Tourists are not usually attracted to areas where onshore activities are heaviest. Rapid industrial growth in some coastal areas could cause a decline in tourism. Because the recreation required in a community is a function of the size of the population and its demographic characteristics, population change due to OCS oil and gas activities would alter recreational demand and supply in the community.

Funds for recreation may be sharply increased by revenue collected from offshore oil and gas extraction. The Land and Water Conservation Fund is the major Federal grant program to the states for purchasing and developing outdoor recreation areas. This fund also has been used to purchase recreation areas and endangered species lands in national forests, parks, wilderness areas, wildlife refuges, and wild and scenic rivers. The U.S. Department of the Interior, Bureau of Land Management (1981) reports that 65% of the revenue for the fund are derived from bonuses, leases, and royalties stemming from exploration and production of oil and natural gas from Federal OCS areas.

Oil spills from pipelines sometimes are caused by damage from dragging platform anchors and bottom trawls. Blowout spillage is caused by producing wells. A serious blowout in 1980 in the southern gulf area off the coast of Mexico threatened one of the world's richest shrimping and fishing grounds.

Severe storms sometimes cause oil spills. In 1964, about 12,000 barrels of oil were spilled from storage tanks in Louisiana during Hurricane Hilda. Accidental oil spills from tankers and barges and oil discharged under normal operating conditions are the major oil spill sources. A large spill can kill birds and marine organisms, weaken key links in the food chain necessary to support sport fisheries, and modify coastline habitats. In addition to biological impacts, oil spills can diminish aesthetic and socioeconomic values, and foul fishing boats and gear.

Potentially, any one of four levels of OCS oil and gas activity could threaten Northwest Florida (Hodecker 1981). Exploratory drilling likely would not cause measurable onshore impacts. A low-find scenario near the gulf coast of western Florida could require a small permanent supply base and repair and maintenance yards, and other ancillary services. Pipelines would be needed to carry the crude oil to marine terminals where the crude would be stored. Gas processing and treatment plants would be located at each landfall site. A medium-find scenario would require two permanent bases in Northwest Florida, two pipelines, two marine terminal facilities, and two gas processing plants if oil fields are located offshore.

For high-find oil and gas operations, at least two and possibly three bases would locate in Northwest Florida. Ancillary facilities, two pipelines, marine terminals, and gas processing plants would locate at each landfall site. A refinery may be needed in Northwest Florida if discoveries of oil and gas are high (Hodecker 1981).

Based on data provided by the New England River Basins Commission (1976), Dzurik in his synthesis paper on "Minerals" provided tables of the general impacts from siting various OCS onshore facilities. These impacts, in terms of employment and land area needed for a high-find scenario, are given in Table 8. Over 3,000 acres of coastal land and 3,000 linear ft of waterfront would be needed for OCS onshore facilities. Some of this loss would be recreational land. Using the demand factors for various types of recreation, estimates of the number of recreation days required by the additional employment related to OCS activities can be made (Table 9). Over 11,000 days of various recreation activities would be demanded by those employed by OCS related industry.

Table 8. Onshore facilities and number of jobs required to support a high-find of oil and gas in the Outer Continental Shelf near Northwest Florida (adapted from the New England River Basins Commision 1976).

Facility	Land measure	Number of jobs required
Service bases	100 acres/base, 600 ft water frontage per base	80 jobs per platform during drilling and production
Pipelines	100 ft easement/pipeline 190 acres per pipecoating yd and pumping station 850 lineal ft of water frontage	500
Berthing facilities (terminal and tank form)	150 acres 1,000 lineal ft of water frontage	75
Platform fabrica tion yards	800 acres 450 lineal ft water frontage	
Onshore process ing and treat-ment facilities	75 acres	60
Refinery	2,000 acres	600
Total	3,315 acres	1,315

Table 9. Estimated outdoor recreation needs by 2,110 employees hired in relation to OCS oil and gas development based on conditions in 1980.

Type of outdoor recreation	Average man-days of participation per person (X100)	Estimated man-days[a] of recreation
Freshwater sport fishery	14	299
Saltwater sport fishing	84	1,722
Hunting	4	84
Saltwater beach recreation	321	6,773
Freshwater swimming	13	274
Recreation vehicle camping	124	2,616
Tent camping	5	106
Historical and archaeological	65	1,372
Canoeing	2	42
Hiking	42	886
Bike riding	109	2,300
Golf	49	1,034
Tennis	28	591
Swimming pool use	165	3,482
Total		21,634

[a]Average per person times 2,110.

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COMMERCIAL AND SPORT FISHERIES

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INTRODUCTION

OVERVIEW

The State of Florida is known for its valuable coastal resources and their potential. The State has 11,000 miles of tidal shoreline (second longest in the United States) and over 15 major estuarine systems. Climatic conditions range from sub-temperate to tropical. The vegetation ranges from tropical hammocks of the Keys to the massive mangrove stands in southwest Florida, and to the juncus and spartina marshes of northwest Florida and the panhandle. These habitat types are undergoing more and more stress. About 75% of Florida's more than nine million residents (1980 Census) live within a few miles of the coastline and over 60% of the 36 million tourists who come to Florida annually engage in fishing, swimming, sun bathing, boating, beach combing, and other water-related forms of recreation. In combination, these activities are depleting or threatening Florida's natural coastal resources.

This paper concerns the sport and commercial fishing industries, the fishes and their biology, and fish production, value, and management. Much of the catch data are from the National Marine Fisheries Service annual catch reports. Much of the economic analysis is provided in publications by Cato (1973), Prochaska (1976), Prochaska and Cato (1977), Prochaska and Morris (1978), and Prochaska et al. (1981) at the University of Florida in Gainesville. Much of the biological data are from Steidinger (1980).

Northwest Florida (Bay, Escambia, Franklin, Gulf, Okaloosa, Santa Rosa, and Walton Counties) is not as heavily developed as other areas of Florida largely because it is not as densely populated. It has some of the most beautiful beaches in the State, and abundant, varied, and highly valued sport and commercial marine fish species. Despite increasing growth, there is still ample time to more effectively consider fish and wildlife resources and their habitats in the planning of water and land use, and for protecting aquatic resources. For example, planning could consider potential environmental damage caused by dredging and filling, saltwater intrusion into groundwater supplies, loss of fresh water to the estuaries, and the effects of pollution on estuarine waters. Many of the findings and much of the data in this report were based upon or reported from Tables FSH-1 to FSH-51, in the Data Appendix.

COASTAL RESOURCES

Four large estuaries dominate Northwest Florida. The first is Pensacola Bay (consisting of Escambia and East Bay and Santa Rosa Sound), formed by the confluence of the White River, Blackwater Bay, and Yellow River. Of the estuaries in Northwest Florida, the Pensacola estuary is most severely polluted, especially by industrial wastes. Heavy fish kills once were relatively common but pollution control requirements and public protests have brought about some improvement in pollution control in recent years, but fish kills have not yet been completely eliminated.

The second is Choctawhatchee Bay, one of the largest single bay estuaries in Florida. Numerous small creeks and rivers, such as Black Creek and Choctawhatchee River, contribute to it.

The third is St. Andrews Bay at Panama City consisting of West Bay, North Bay, and East Bay; the fourth is Apalachicola Bay by far the largest and most productive estuary. The bay is fed primarily by the Apalachicola River, and is made up of Indian Lagoon, St. Vincent Sound, Apalachicola Bay proper, East Bay, and St. George Sound. Further information on the characteristics of the Bay and Apalachicola River are reported by Livingston (1975) and Livingston and Joyce (1977).

The offshore waters of these large estuarine nursery areas support extensive sport and commercial fisheries. The locations of about forty sport and commercial fishing concentrations have been identified by Moe (1963). He divided Northwest Florida into the Upper West Coast (characterized by a gentle gradient of the Continental Shelf within the 50-fathom contour almost 100 miles from the coastline) and the Northwest Coast (characterized by DeSota Canyon, a deep basin of sea water close to shore). In both areas, sport and commercial fishing is good near rock outcroppings, ledges, cliffs, gullies, and other topographic features of the bottom that are good fish habitat.

COASTAL CURRENTS

Prevailing ocean currents of the Gulf of Mexico are complex and contribute to the characteristics of the biology of the Florida gulf coast. Drift bottle data and current monitoring via satellite imagery are contributing to a better understanding of the diverse factors that influence mass water transport. A 28-month study by the Florida Department of Natural Resources on the West Florida Shelf revealed that bottles released in the winter tended to drift to the eastern Florida coast and Keys, and those released in spring and summer tended to drift to the lower west coast (Tampa to Fort Myers) and to the western Gulf of Mexico. Recent data from satellite imagery has confirmed that these tendencies are extremely variable and depend strongly on the Loop Current development (intrusion, spreading, eddy formation, and drift), which itself is unpredictable and significantly affected by short term variation and the influence of prevailing local winds (Williams et al. 1977). Although unpredictable, the Loop Current, its eddies, wind effects, and other variables closely link Florida's Western Shelf with other coastal waters of the State. Transport of red tide by these currents also has been documented (Steidinger 1981). Such currents could also transport hazardous substances, such as oil spills from the lower west Florida coast to the northwest or east coast if conditions were suitable.

COMMERCIAL FISHERIES

Fishing along Northwest Florida began as a subsistance fishery centuries ago. Extensive shell middens attest to the importance of fish and shellfish in the Indian's diet. Although fishermen early in this century were adequately equipped with boats, equipment, and gear such as beach seines, gill nets, and shrimp trawls, inadequate transportation and storage and preservation facilities prevented large scale production. A day's catch usually was limited to the amount that could be sold the same or next day. Today's modern fishing industry with its complex of vessels, electronic equipment, freezing and storage facilities, transportation, and marketing systems bears little resemblance to its predecessors. A major holdout is the oyster industry. Approximately 90% of Florida's oyster production is supplied by Franklin County (Apalachicola Bay) where, by law, the major fishing method (hand-operated oyster tongs) has not changed in three generations. But, even here, improved regulations and industrial operations have brought about improvements in processing, storage, and transportion.

Because of rapidly rising food prices, the fishing industry is broadening its base by fishing for less acceptable and less expensive fish and by preparing new products. Examples are schooling fish (especially mullet, croaker, trout, and redfish) caught by gill nets in estuaries and nearshore waters.

A recent survey conducted by the Bureau of Marketing and Extensive Services of the Florida Department of Natural Resources gives data on the economics of the fishermen, the fishery, the markets, and other socioeconomic trends. A survey of 142 wholesale and retail seafood markets in north Florida, south Georgia, and south Alabama documented the importance of low priced, net-caught fish in ethnic diets, particularly for Blacks, but the public's attitude toward net fishing is becoming increasingly negative. Fishing restrictions prohibiting nets will disproportionately affect particular ethnic groups.

FISHERY RESOURCES OF NORTHWEST FLORIDA

Although over one hundred species of finfishes and shellfish are caught by commercial and sport fishermen in the Northwest Florida, information on sport fish catches is scanty. The National Marine Fisheries Service (NMFS) conducted interviews and telephone surveys to determine the magnitude of the sport catch in the United States (Deuel and Clark 1965, Deuel 1970, U.S. Department of Commerce 1975). A creel census by the Florida Department of Natural Resources measured the sport catch in Choctawhatchee Bay in Okaloosa and Walton Counties. Attempts are now underway to establish continuing commercial and sport catch statistics through State/Federal cooperative agreements.

In Florida as in most places, sport fishermen and commercial fishermen seek the same species. The exceptions in Florida are sailfish (*Istiophorus platypterus*), tarpon (*Megalops atlanticus*), snook (*Centropomus undecimalis*), and bonefish (*Albula vulpes*) which are illegal to sell. Sometimes, there is strong competition between sport fishermen and commercial fishermen for the same fish stocks and the same fishing grounds. For some species, sport catches equal or exceed commercial landings. The catch and value of commer-

cial landings are relatively easy to get, but statistics on sport fishing and its related industries (e.g. out-of-state fishermen, tackle, boats, motors, oil and gas, food marinas, and hotel-motel accommodations) are difficult to obtain despite the great economic value of the sport fishery.

Annual changes in commercial landings should be analyzed with considerable care. For example, several years of steadily declining catches do not necessarily indicate that the species is overfished. The decline may be caused by natural fluctuations in abundance, or by a decline in commercial fishing intensity or a number of other possible factors. Details on commercial fishing operations, the need for facilities, and commercial fishing port development are reported by Mathis et al. (1978a and 1978b).

FINFISH

Ordinarily, seafood is divided into finfish (referred to as fish hereafter in this report) and shellfish (e.g., oysters, shrimps, crabs). In addition to their commercial value, finfish support a highly valued sport fishery.

Snappers and Groupers

The red snapper, Lutjanus campechanus, is a long-lived (up to 20 years), slow growing, continental shelf reef dweller that is essentially non-migratory except for seasonal inshore-offshore movement. It is one of the most highly valued marine fish in Florida. In 1980 it contributed about 2.2 million lb valued at $3.9 million dockside to the commercial catch in Northwest Florida. Red snapper also are highly prized by sport fishermen, particularly in head and charter boats.

Commercial landings of the groupers, primarily red grouper (Epinephelus morio), gag grouper (Mycteroperca microlepis), and scamp (Mycteroperca phenax) in Northwest Florida in 1980 were 1.3 million lb, valued at $1.2 million. This catch is only about 10% to 15% of the total Florida catch and has varied significantly in 1970-80, ranging from a high of 1.4 million lb in 1972 to a low of 528,844 lb in 1977. Groupers also are important sport species, especially for head and charter boats.

Relatively little is known about the early life history of groupers and snappers. The biology of only a few of the larvae are properly described and specific spawning areas are unknown. Most of the observations on these species in this report were from Beaumariage and Bullock (1977) and Futch and Bruger (1977). Most groupers probably spawn in deeper coastal waters in spring, summer, and fall. Pelagic larvae are transported by prevailing currents into bays and estuaries, which are used as nursery grounds. As juveniles, they move from shallow reef or grassy areas to deeper holes or hard bottom outcroppings. Adults seldom stray far from protective hard rock outcroppings, reefs, or corals. Of the groupers, biological data on the gag probably are most extensive. This species in its second year of life is about fourteen inches long and weighs between 2 and 3 lb. The largest groupers landed commercially are five or six years old and average from 9.0 to 11.7 kg (20 to 25 lb) each. Sexual maturity is reached in 2 to 4 years. A maximum age of 30 years was reported. Most groupers are protogynous hermaphrodites and begin life as females. Transformation begins at about age six, but not

all become males. Factors influencing sexual change are not well understood. The transformation possibly prevents the loss of males from the highly territorial populations found in the relatively isolated reef areas.

The increasing catch of snappers and groupers by commercial and sport fishermen may be reducing their abundance. For example, in recent years overfishing in some areas is indicated by the declining average size of fish caught.

The relatively great distance of fish populations offshore and rising fuel prices may depress the sport fishery, yet commercial fishing for these species in coastal waters may increase even further because Mexican fishing grounds now prohibit U.S. fishermen.

The Mackerels

The mackerel (Scomberomorus spp.) are a valuable sport and commercial fish in the coastal waters of Northwest Florida. They are two of the most popular sport species; estimates indicate that the sport catch is about three times greater than the commercial catch. The fishery management plan for pelagic coastal fishes in Florida currently under preparation by the Gulf of Mexico and South Atlantic Regional Fishery Management Councils (Public Law 94-265) seeks to allocate 9 million lb annually to commercial fishermen (approximately 5 million to nets and 4 million to hook and line) and 29 million lb to sport fishermen. Competition between sport and commercial fishermen and between various groups of commercial fishermen is a serious problem. Several legislative attempts to restrict specific types of fishing have been made (e.g., making net fishing for mackerel illegal or banning commercial fishing for the species altogether).

King mackerel. Although a valuable sport fish in Northwest Florida, commercial production of this species (Scomberomorus cavalla) is only a small part of the State total. Florida landings averaged about 6.5 million lb annually in 1970-80 and Northwest Florida's commercial landings fluctuated from 34,000 lb to 241,173 lb. The value of the catch from Northwest Florida in 1980 was $97,533 for the 182,970 lb landed. Monthly landings in 1965, 1970, and 1975 for the Florida west coast are given in Table FSH-24 in the Data Appendix.

King mackerel begin spawning when three years old (males) and four years old (females). Spawning from May to September has been well documented in offshore waters of Texas and Northwest Florida and from Florida to North Carolina along the Atlantic coast. Relatively little is known about the juveniles although some are occasionally taken nearshore in shrimp trawls. King mackerel may live 13 to 14 years, but most are less than seven years. Adult mortality is estimated at about 50% per year.

Tagging studies have shown extensive migrations. Some of the king mackerel tagged in the winter along the southeast Florida coast migrated into the Gulf of Mexico in the spring and migrated as far as eastern Texas and Mexico in the summer. Most return to Florida waters in fall and winter. King mackerel also migrate along the Atlantic coast; fish tagged in southeast Florida were caught from as far north as Virginia. Data so far indicate that there

are probably two populations of king mackerel but that there is some evidence of mixing in the South Florida area.

Despite heavy exploitation of the king mackerel, biological evidence indicated that the abundance of the species has remained relatively stable for many years (Beaumariage, personal communication).

The availability of the fish stocks sometimes change sharply because of their migratory habits and response to changing currents, climate, and other conditions. Whatever the cause, sport and commercial fishermen tend to blame each other when their catches are below their expectations.

Spanish mackerel. Spanish mackerel (*Scomberomorus maculatus*) also are important to sport and commercial fishermen in Florida. Spanish mackerel are smaller than king mackerel and usually do not live as long (maximum age is about eight years). Age 2 and older fish spawn in waters over the Inner Continental Shelf (40-165 ft) from May through September (Powell 1975). Spawning has been documented in coastal waters from Cape Sable to Mobile Bay and from Georgia to the Chesapeake Bay. The biology of juveniles is not well documented, but they grow rapidly and enter the fishery in their second year of life when they are most abundant.

The commercial catch in Northwest Florida in 1980 was about 613,979 lb (18% of the State total), valued at $170,494 dockside. The monthly landings for 1965, 1970, 1975 for the west coast of Florida are given in Table FSH-25 of the Data Appendix.

Spotted Seatrout

The spotted seatrout (*Cynoscion nebulosus*) is highly sought by sport and commercial fishermen. Although there are no sport catch statistics, the sport catch probably equals or exceeds commercial landings. Commercial catch data are complicated by the large proportion of trout in the market that were caught by sport fishermen and sold. Some fish markets in Florida are heavily dependent upon sport catches to meet their demands.

Spotted sea trout in Northwest Florida is considered one of the most important estuarine sport fish. Commercial landings in 1980 were 192,072 lb valued at $131,399 dockside (less than 10% of the statewide landings). The 1980 landings were the lowest in 1970-80 and the 1976 landings (432,657 lb) were the highest.

The spotted seatrout is an estuarine dependent species that spends all or most of its life in estuaries. Some populations are so distinct that they exhibit different racial characteristics from those in adjacent bay systems. This species spawns in the deeper waters of estuaries in the spring and summer, mostly in April to July. In southern Florida, some spawn year round. Males first spawn when 1 to 2 years of age; female at 2 to 3 years of age. Maximum age is generally 8 years. A literature review of the life history of the spotted sea trout in the Gulf of Mexico was reported by Lassuy (1982).

Commercial landings of spotted seatrout in 1951-76 have declined in some parts of Florida. Some loss may be due to overfishing, but most scientists believe that degradation of habitat by dredge and fill operations, pollution,

decreased freshwater inflow to estuaries, and other water and land alterations are the real cause. The monthly commercial landings for the west coast of Florida in 1965, 1970, and 1975 are given in Table FSH-27 in the Data Appendix.

Striped Mullet

The black or striped mullet (Mugil cephalus) is commercially the most important of five species of Mugil in Florida. With the exception of 1974, striped mullet dominated the commercial landings in Northwest Florida in 1970-80, but because of their relatively low dockside price, their dollar value was less than that of the groupers and snappers. In 1980, commercial landings in Northwest Florida were valued at $998,178, whereas State landings were 30.9 million lb valued at $6.1 million.

Striped mullet spawn in offshore waters from October to January. Larvae have been collected from the Gulf of Mexico and the Atlantic Ocean as far north as Cape Cod, Massachusetts and near the surface in water up to 900 fathoms deep. When 20 to 30 mm long, the larvae move into the estuaries and, except for spawning or seasonal movement to offshore waters, they live the remainder of their lives there.

Adults first spawn when they are 2 to 3 years old; females typically grow larger and live longer than males. Adult mullet sometimes inhabit fresh waters and move long distances up rivers. Landlocked populations have been reported in Florida, Texas, and Oklahoma. Maximum age is six to seven years and maximum length is about 30 inches. Juvenile and adult striped mullet are primary consumers, feeding largely on diatoms, algae, and benthic detritus. They have a muscular gizzard that helps grind their food.

Despite high production, striped mullet is considered an underutilized species. When fresh, it is ranked by some consumers to be one of Florida's finest eating fish, but because it is a relatively oily fish subject to rancidity, it has an extremely short shelf life. Mullet are taken commercially primarily in the fall and early winter when they tend to school prior to moving offshore to overwinter and spawn. This strong seasonal availability is troublesome because the markets usually become glutted and prices fall. Currently there is a strong market in Japan for mullet roe for caviar. This relatively new product has helped the mullet fishing industry in Northwest Florida.

Lady Fish

Lady fish (Elops saurus) is an important bait species in Northwest Florida because of its size schooling habits, and its availability to the purse seine fishery. Lady fish are used largely for crab bait. In 1980, the dockside value was about 5 cents a pound. The 1.3 million lb taken that year were worth $71,386 dockside. About 95% of the State landings were from Northwest Florida.

The monthly commercial landings for lady fish for the west coast of Florida in 1965, 1970, and 1975 are given in Table FSH-35 in the Data Appendix. Although this species is not usually sought by sport fishermen because of their poor food quality and small size, some are taken when more desirable

species are not biting. Their fighting ability has earned them the reputation as a "poor man's tarpon."

Lady fish are estuarine dependent but spawn offshore. Little is known of their age composition and growth, but it is clear that they grow rapidly and have a short life span.

Other Finfish

Tha catch of the fish species just described is only a small percentage of the total catch of over 75 species. Other valuable species are used for food, bait, and as a source of oil, fish meal, and pet food. Valuable sport species such as tarpon and sailfish are prohibited from commercial trade. These fish support annual fishing tournaments along the Florida coast and contribute substantially to marine related industries, e.g. tourism, retail sales of fuel, fishing equipment, boats, nets, ice, and storage.

SHELLFISH

By far the most valuable marine species produced for market in Florida are shrimp, blue crabs, oysters, and scallops. These highly productive, estuarine dependent species are heavily fished throughout their range by commercial fishermen. Sport fishing for these species is heavy in some areas, but it does not contribute as much to the total catch as does sport fishing for finfish. Shellfishes have a relatively short life span (from 1 to 5 yrs) and high fecundity.

Shrimp

Shrimp is Florida's most valuable marine resource. In Northwest Florida, four species (white, brown, pink, and rock) make up almost the entire catch. In 1980, about 6.3 million lb of shrimp worth $8.4 million dollars dockside were produced. The monthly commercial landings, and their value, of all shrimps from the west coast of Florida in 1965, 1970, and 1975 are given in Tables 41-42, in the Data Appendix.

Pink shrimp (*Penaeus duorarum*) spawn year-round, but largely in spring and fall in water 12 to 26 fathoms (72 to 156 ft) deep. White shrimp (*P. setiferus*) spawn from spring through fall in water 4 to 17 fathoms (24 to 102 ft) deep. Brown shrimp (*P. aztecus*) spawn from spring to early summer in water 15 to 60 fathoms (90 to 360 ft) deep. Rock shrimp (*Sicyonia brevirostris*) spawn from winter through spring in water 20 to 70 fathoms (120 to 420 ft) deep. About 500,000 fertilized eggs are released into the water column by each female. Some females spawn several times in one season.

Larval development is 15 to 30 days long depending upon water temperature. Larvae remain in offshore waters until attaining the postlarval stage when they utilize tidal currents and salinity gradients to enter the estuaries. The pink, white, and brown shrimp use various portions of bays and tidal marshes for nursery areas, whereas rock shrimp use higher salinity bays and nearshore areas out to depths of 10 fathoms (60 ft).

Juvenile growth in the estuary is rapid, requiring only 3 to 4 months to maturity. As water temperatures cool in the fall and shrimp reach lengths of 3 to 4 inches, they emigrate from nursery areas, using tidal currents and salinity gradients to move to overwintering and spawning grounds. Some of the younger, smaller shrimp may overwinter in deeper portions of bays until spring and then move offshore.

Major pink shrimp fishing grounds are along the southwest coast from Fort Myers to Tortugas and from Apalachicola Bay to Panama City. White and brown shrimp are most abundant near Apalachicola Bay and Jacksonville. Rock shrimp are most abundant near Apalachicola Bay and from Cape Canaveral to Georgia. They become sexually mature (3.5-4.0 inches TL) near the time they arrive at their overwintering grounds. They are 6 to 8 months old and of legal size (47 whole shrimp per pound or 70 tails per pound). Growth slows as they move deeper offshore. Maximum age is about 2 years; but few live longer than 12 to 14 months.

Shrimp larvae feed on algae and zooplankton. Post larvae, juveniles, and adults are omnivores, feeding largely on detritus and microorganisms.

Blue Crabs

The blue crab (Callinectes sapidus) supports a major fishery in Northwest Florida. In 1970-80, annual landings ranged from 1.2 to over 2.3 million lb. The average price per pound dockside was 22 cents and the 1980 landings of 1.9 million lb had a dockside value of $401,686. Northwest Florida contributes about 10% of the total Florida blue crab catch. The monthly landings of blue crabs along the west coast of Florida in 1965, 1970, and 1975 are given in Table FSH-36 in the Data Appendix.

Blue crabs mate and spawn year-round except in northern areas of Florida when water temperatures drop below 60°F. Subsequent to mating in brackish waters (8-18 ppt salinity), females migrate to nearshore high salinity waters (25 ppt) near mouths of estuaries to spawn. Alongshore migration on the west coast towards Apalachicola Bay by some females suggests that the bay area may be a primary spawning area. Females spawn at least twice, producing from 700,000 to 2,000,000 eggs per "sponge." Spawning peaks in April-June.

Blue crab larvae go through zoea stages lasting 31 to 49 days and one megalopa stage lasting 6 to 20 days. Zoea are planktonic until molting into the megalopa stage, which utilizes tidal currents to drift into estuarine waters where they molt into the first crab stage (2-3 mm carapace width [CW]).

Small crabs (40 mm CW) live in a variety of shallow water habitats in the estuary (e.g. grass beds, muck bottoms) and gradually move to deeper water as they increase in size. Adult size (120 mm) is achieved after 18 to 20 molts in 12 to 14 months.

The size range of adults usually is 120 to 140 mm CW, most of which are commercial size. After reaching adult size, crabs are known to live at least one more year, and a few may live 3 to 4 years. Primarily a shallow water species (up to 35 m deep), adult blue crabs live in a variety of habitats ranging from gulf waters with 34 ppt salinity to inland freshwater rivers up to 120 miles from the coast. Annual commercial landings in Florida in 1968-78 averaged 17 million lb.

Oysters

Over 90% of Florida's oyster production is from the Apalachicola River estuary; the oyster industry is second only to shrimp in Northwest Florida. Income from the landings is a major source of income in Franklin County. In 1980, landings of 6.6 million lb yielded a dockside value of $5.9 million. Since 1977, the annual production of oysters has slowly increased. Some of the increase may be attributed to opening June, July, and August for oyster fishing. The potential for oyster production throughout the region is threatened by further coastal development for marine transportation, and for residential, business, and industrial purposes.

The monthly landings of oysters on the west coast of Florida in 1965, 1970, and 1975 are given in Table FSH-39.

Oysters usually spawn April-October and individuals may spawn several times in a season. Fertilization is external and requires simultaneous release of sperm and eggs by animals in close proximity. Fertilized eggs sink rapidly, and the trochophore larval stage is reached in 4 to 6 hours. This is followed in 24 to 28 hours by the veliger (larval) stage. These ciliated pelagic forms drift for 2 to 3 weeks and distribute the oysters. When mature larvae, known as spat, contact suitable hard substrate, they settle and attach permanently.

Oysters grow rapidly after settling on suitable substrate. In Florida, a marketable oyster is generally less than 18 months old. Besides suitable substrate, oysters require adequate water flow, salinity, and temperature for growth and survival. Good water circulation not only aids in their dispersal, but assures transport of nutrients and removal of wastes. Wide salinity fluxes tolerated by oysters may be beneficial in controlling the abundance of predators that require high salinities. Permanent communities do best in a salinity range of 10 to 20 ppt. Oysters also have a wide temperature tolerance, but best growth is near 75°F.

Bay and Callico Scallops

Landings of callico scallops (*Argopecten irradians*) in Northwest Florida vary greatly from year to year, ranking from none early in the century to over 1.8 million lb in 1976.

Many marine species vary widely in abundance, but annual fluctuations for scallops are even more extreme. Although scallops have only limited mobility, it has been conjectured that mass movement of a population might possibly explain the disappearance of a large bed. Mass movements have not been scientificially verified, and the periodic disappearances of a major portion of the population may simply be a result of high natural mortality.

Bay scallops (*Argopecten gibbus*) spawn during fall and early winter in bays, sounds, and other protected areas. Calico scallops spawn offshore in spring and early summer; some spawn year-round. Scallops are hermaphroditic (contain both male and female reproductive organs), but the release of eggs and sperm at different times for the same individual during spawning prevents self-fertilization.

Larvae pass through two planktonic forms in one to two weeks prior to becoming sessile attached postlarvae. Bay scallop postlarvae attach to seagrasses for several weeks before taking on the appearance and lifestyle of adults. Postlarval calico scallops attach to large shells and hard substrate prior to becoming mobile juveniles. Postlarval calico scallops are deposited in "windrows" that follow local current patterns.

Postlarval bay scallops settle in grass beds in shallow water whereas post larval calico scallops settle in water 10 to 40 fathoms deep offshore. They move randomly within these general areas. Bay scallops grow from several mm to about 60 mm from winter through summer and reach sexual maturity by fall. Calico scallops show similar growth rates from summer through winter and reach sexual maturity by early spring when about 60 mm.

Bay scallops live in most Florida estuaries, but the largest populations are in St. Joe Bay, and near Anclote Key, north of Tampa Bay. Bay scallops once were common in Pine Island Sound until the population was reduced by a combination of red tides and habitat alterations (particularly dredge and fill operations in the 1950's and 1960's). Calico scallops live in most offshore areas of Florida, but are most abundant near Apalachicola Bay and Cape Canaveral. Bay scallops generally live in the same bay system each year, whereas the location of calico scallop beds may vary each year, depending upon where the postlarvae are deposited. Maximum age is about two years. Nearly all die after spawning. Scallops are filter feeders, consuming microscopic phytoplankton.

The monthly landings of scallops on the west coast of Florida in 1965, 1970, and 1975 are given in Table FSH-40 in the Data Appendix.

PROBLEMS OF RESEARCH AND DEVELOPMENT

THE STATUS OF RESEARCH

In the early 1900's very little was known about the biology of the major sport and commercial saltwater and estuarine fishes of Florida. Following World War II, interest in fishing as a vocation and an avocation began to increase and with it the need to understand the natural history of the more important species.

In the 1950's and 1960's, many papers were written about a variety of marine resource topics. Collectively from these and other more recent reports, major concepts began to emerge concerning the living marine resources. Most significant among these was the estuarine dependency of over three-fourths of the major commercial and sport species. Studies of these species indicated that at least part of their life cycles depended upon the shallow estuarine areas (nursery grounds) where food and protection for young fish or shellfish abounded in a variety of forms. The biological richness and importance of these nursery grounds were difficult to convey to the general public, and thousands of acres were lost to indiscriminate dredging and filling before protective legislation was finally passed.

Research now is more advanced, better funded, and the evidence continues to illustrate the importance of estuaries for sustaining fish and shellfish.

HABITAT ALTERATION

For the majority of species studied, the availability and capacity of habitat is a major limiting factor of species abundance. The rate of loss of habitat has been greatly reduced in Florida recently by protective regulations. No longer can developers move freely into a marsh or estuary and indiscriminately dredge and fill to create waterfront (canal) home sites such as that done in Boca Ciega Bay near St. Petersburg. Although dredging determined to be "in the public interest" continues, the massive projects of the 1950's and 1960's now are a rarity. Habitat loss today is more subtle; an acre or two, a small boat channel, a causeway, all of which have cumulative effects. Not only is the area of wetlands being reduced, but the productivity of the remaining wetlands is declining. The decline in habitat productivity is most frequently caused by (1) loss or diversion of freshwater from estuarine systems and (2) sewage, chemical, industrial, and thermal pollution, and oil spills.

With the increased demand for coastal fishes and the proven dependence of these fishes on estuaries, the need for increased habitat protection in coastal wetlands is paramount. Some of the current water and land use changes and developments or practices that are still damaging the estuaries and which should be eliminated or at least regulated are: (1) diversion of freshwater inflow from the estuaries, (2) diking or impounding estuarine marshlands for mosquito control, (3) spraying of insecticides on watersheds, wetlands, and shallow estuarine shorelines for mosquito control, (4) the construction of causeways or other structures for highways, and (5) navigation channel maintenance.

Some land management practices, which usually are several miles upstream from an estuary, also may unfavorably alter habitats. Principal examples are: (1) clear cutting of forests or woodlands, which alter surface runoff, stream flow, and groundwater supplies, (2) excessive use of pesticides, herbicides, and fertilizers in agricultural operations, and (3) damming or otherwise altering river flow patterns.

In view of man's destruction and alteration of habitats, many possibilities for restoration have been examined. For example, spoil islands or eroding dunes can be vegetated to increase stability and maintenance of natural habitat. Permits issued for land alteration (in the public interest) may require mitigation for habitat loss.

Under certain conditions, some natural habitats may become more productive by the addition or construction of new habitat features. For example, the construction of artificial fishing reefs on flat or low relief bottoms attracts and concentrates fish so that they are more available to sport fishermen. The construction of shell reefs in appropriate waters may sharply increase the area for attachment of oyster spats and increase oyster abundance. Oyster beds or reefs constructed by the Florida Department of Natural Resources in Apalachicola Bay since 1949 now account for a major share of profitable oyster beds. This and other forms of restoration of loss or damaged

habitat, and even the improvement of natural areas, have been made possible through extensive research and should be a prime consideration in marine resource management.

SPORT FISHERIES

A clear definition of a sport and a commercial fisherman and their similarities and differences sometimes are highly debatable. There are commercial fishermen who fish for pleasure and sport fishermen who sell their catch. Often they both seek the same species and fish the same spawning grounds. Among the fishes that cannot be sold legally, no matter how they are caught, are sailfish, tarpon, snook, and bonefish. Most mullet and shrimp are taken commercially, but even these sometimes are caught by sport fishermen that use small seines, gill nets, and cast nets. The sport catch of some of the most favored fish species sometimes equals or exceeds the commercial catch. Compared to most states, the economic value of the sport fishery in Florida is unusually high.

In Florida, there are more than 500,000 registered boats, many of which are used by sport fishermen and 36 million annual tourists, many of whom go sport fishing. Major sport fishes are king and Spanish mackerel, grouper, red snapper, spotted seatrout, redfish, cobia, flounder, and whiting. Large numbers of other species also are caught.

A 12-month creel census in Choctawhatchee Bay revealed that although speckled sea trout was one of the most popularly sought fish, fin fish were most abundant in landings. Offshore catches were highest for king mackerel and red snapper. In Choctawhatchee Bay, head and charter boat fishing accounted for 50% of the fishermen and 75% of the sport catch, whereas sport fishing from shore, piers, and private boats accounted for only 35% of the sport fishermen and 16.4% of the catch. Tourists comprised 95% of the fishermen using party and charter boats. In recent years, more fishing has been directed toward sailfish and the larger billfish in the DeSota Canyon where depths range from 40 to 100 fathoms (240 to 600 ft). Shark fishing also has become more popular. Fishing tournaments and contests for sport fish are common along the Florida coast.

BAIT INDUSTRY

The great increase in sport and commercial fishing since about 1958 has created a high demand for natural bait. Almost any species can be cut up and used for bait, but only a few enter the trade in large quantity. Favorite baits are squid, shrimp, mullet, ballyhoo, halfbeaks, herring, cigar minnows, lady fish, and goggle eyes. With the exception of shrimp, most of the bait is sold dead, either fresh or frozen. Silver mullet, ballyhoo, and some of the herrings are caught for bait in commercial gears. Some are sold whole, especially for sailfish, billfish, and king mackerel fishing. The majority are sold to party and charter boat anglers and the success of the trip often depends on the availability of the proper bait.

The most valuable and useful bait is live shrimp. In Florida, shrimping for bait is conducted primarily in the nursery grounds and is permitted in lo-

cations and at times when shrimping for food is illegal. Part of the justification for this leniency is the self-limiting nature of the shrimp bait fishery. For shrimp to be kept alive, the vessel must be equipped with recirculating water holding tanks and a small shrimp trawl that is towed for only short periods of time. Short hauls with small trawls keep shrimp mortality at low levels and reduces the catch of other fishes.

The size of the bait industry will continue to be closely tied to the success of the sport fishery.

MARICULTURE

Mariculture is the commercial cultivation of marine fish or shellfish. The high reproductive potential of most marine species and the increasing value of most seafood has drawn much attention to the possibility of "farming the sea." Most mariculture experiments in Florida used pompano (Trachinotus carolinus), freshwater shrimp (Macrobrachium spp.) and brackish water shrimp (Penaeus spp.).

Attempts have been made to cultivate saltwater shrimp. One company invested several million dollars and produced several hundred thousand pounds of shrimp a year, but there are many problems that are yet to be solved. Their greatest success was in two 300-acre ponds into which the cultured postlarval shrimp were stocked and fed until they were of harvestable size. In earlier years, the company attempted to cultivate shrimp in 2,500 acres of fenced bay bottom, which required the first State "mariculture" lease. A continuing series of problems ranging from hurricanes and high tides, to having the nets sink from an accumulation of fouling organisms (e.g., barnacles) ultimately forced them to abandon this method.

Despite a number of experiments, mariculture in Florida is still in the developmental stage. Major problems have been the high cost of labor and land, low winter water temperatures, and biological problems associated with mass culture. The most successful mariculture prospects in Florida were moved to Central or South America where these problems were much less troublesome. One of the better potentials for mariculture is in saltwater aquaria. Some of the brightly colored reef fishes may sell for over $50 each and their culture could be extremely profitable as long as the market price remains stable.

RESOURCE CONCERNS AND ISSUES

FLUCTUATIONS IN CATCH

One of the long-established biological characteristics of marine fish is their fluctuating abundance. Despite years of study, there is little direct evidence that points to the causes. Although there is speculation that unusual weather changes are partly responsible, unusually low water temperatures many cause high natural mortalities among estuarine species. Low freshwater inflow may cause excessively high salinity and poor reproduction. Low salinities after major floods may produce the same results.

Information about the abundance of most species of fish is based on relative measures, e.g., changes in commercial catch. The only consistent annual commercial catch statistics available are those collected by the National Marine Fisheries Service. Changes in commercial catches require careful analysis. For example, production declines for several years do not necessarily reflect an actual decline in the abundance of the species. Although a decline in catch may simply be caused by a decline in fishing intensity, catastrophic declines or long term trends usually become clearly apparent.

THE SHRIMP INDUSTRY

Characteristically, the abundance of shrimp in Florida varies widely among the years. As with most estuarine-dependent species, the availability and productivity of nursery grounds generally is the major limiting factor of abundance; consequently, shrimp abundance is more accurately related to habitat loss or alteration than to overfishing.

The high cost of fishing is the shrimp industry's major problem. Fuel costs have risen rapidly over the last several years and the cost of each pound of shrimp produced has increased several times. Imported shrimp from Mexico are price competitive because fuel prices there are government controlled at relatively low levels. Now the market price per pound of shrimp in Florida greatly exceeds that of red meat and often even exceeds the price of high quality cuts. High costs have reduced consumer sales; almost 80% of all shrimp in the United States are sold to restaurants. These economic problems are creating demand for additional controls on the industry, such as limited entry (e.g., restrictions on the number of fishermen). By reducing the number of shrimp boats (which now exceed the numbers necessary to catch the available shrimp), individual catches would increase and retail prices probably would drop. Limited entry would require major legislation and would have far-reaching effects. In some states limited entry often creates as many problems as it solves. Limited entry will be discussed further in a later section.

Another major problem of the beleaguered shrimpers is the incidental catch of threatened and endangered species of marine turtles. Turtles are caught in shrimp trawls during normal operations and drown if held underwater by the net long enough. Emotion over this problem is so high that some people have suggested that the shrimping industry should be closed. The shrimp industry is taking steps to keep the mortality of turtles at a minimum. The shrimpers have agreed that when trawling in an area where turtles are abundant, trawling time will not exceed 90 minutes. Most turtles taken in that time should still be alive and can be returned to the water unharmed. The National Marine Fisheries Service is experimenting with net designs that usually will not catch turtles. Recent design advances in the excluder trawl look very promising and large scale testing is planned. These nets have other advantages as well. By excluding large amounts of trash and other debris of unwanted species (such as some types of jellyfish and undersized species of sport and commercial species), they reduce drag, increase catch potential, and perhaps save fuel.

In summary, the shrimp fishery is the most valuable fishery in Florida, but it is confronted with serious economic problems that plague almost all industries. The shrimp industry is likely to undergo many changes, but the demand for shrimp should remain high.

LEGISLATION AND COOPERATIVE ACTION

The most significant marine fishery regulation of this century is Public Law 94-265, the Fishery Conservation and Management Act of 1976, which extended United States jurisdiction of marine fisheries out to 200 miles. To accomplish its purpose, eight Regional Fisheries Management Councils were formed and these quasi Federal agencies have the responsibility of developing fishery management plans for those fish species that live primarily in international waters out 200 miles offshore (Fishery Conservation Zone, FCZ). The law gives U.S. fishermen first rights over all fishing stocks in the FCZ. Foreign fishing is permitted by the councils only when it is determine that a surplus exists beyond that which U.S. fishermen can catch (almost all are low-valued species). Although Florida is a member of two Councils (the South Atlantic Fishery Management Council and the Gulf of Mexico Fishery Management Council), the Northwest Florida's FCZ is under the Gulf Council, which has enacted or is working on fishery management plans for the following species: (1) stone crabs, plan enacted September 1979; (2) shrimp (white, pink, brown, and related species); (3) reef fish (snappers, groupers, and related species); (4) king and Spanish mackerel (cooperative plan with South Atlantic Council); (5) spiny lobster (another cooperative plan); (6) groundfish (primarily species taken incidental to shrimp trawling); (7) sharks; (8) coral (another cooperative plan); and (9) billfish (a four-way cooperative plan with South Atlantic, New England, and Caribbean Councils).

Central to the development and approval of fishery management plans are the Seven National Standards that the Act requires must be met. The plans are as follows:

(1) Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery.

(2) Conservation and management measures shall be based on the best scientific information available.

(3) To the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, but closely interrelated stocks of fish also may be managed as a unit.

(4) Conservation and management measures shall not discriminate between residents of different states. If it becomes necessary to allocate or assign fishing privileges among various U.S. fishermen, such allocation shall be (A) fair and equitable to all such fishermen; (B) reasonably calculated to promote conservation; and (C) carried out in such a manner that no particular individual, cooperation, or other entity acquires an excessive share of such privileges.

(5) Conservation and management measures shall, where practicable, promote efficiency in the utilization of fishery resources; except that no such measure shall have economic allocation as its sole purpose.

(6) Conservation and management measures shall take into account and allow for variations among, and contingencies in, fisheries, fishery resources, and catches.

(7) Conservation and management measures shall, where practicable, minimize costs and avoid unnecessary duplication (PL 94-265).

In addition to protecting and providing for proper utilization of fishes beyond the territorial sea, this act may profoundly affect inshore fisheries as well. As fishery management plans are approved and the results (both successes and failures) are available for review, the individual states may enact similar regulations that will better protect their own fisheries.

Success of the act will depend on how well the councils are able to deal with particularly difficult issues such as limited entry, pre-emption of a state's fishery regulations, and allocation of limited or diminishing resources.

FEDERAL FUNDING

Federal support for fishery research and development, quality control, inspection, low cost loans, and research in Florida has never been great. In contrast to the Northwest Pacific Coast states, which favor salmon, Federal aid in the Gulf of Mexico has never been in proportion to the region's fishery production. Probably the most beneficial Federal aid has been provided through Public Law 88-309, The Commercial Fisheries Research and Development Act of 1964. The act has provided Federal research and marketing funds on a matching basis through the Florida Department of Natural Resources. These funds have been responsible for accelerated research and for the development of the largest seafood marketing program in the southeastern United States. In 1982, Florida's share of PL 88-309 was $240,000.

The Anadromous Fisheries Research and Development Act (PL 88-304) was enacted primarily to assist northern states with the development of anadromous fisheries such as salmon. Benefits of this act to southern and Gulf states were small because of the rarity of anadromous species or fisheries. Florida, and in particular Northwest Florida, received some funds for studies on the Alabama shad and sturgeon.

PL 94-265 (already discussed) also provides some funding potential. The individual fishery councils of the Gulf may contract for needed research through state or private organizations. Although council funds for such outside work are limited, they do not require matching funds.

The Coastal Plains Regional Development Commission, a Title V Commission, already has contributed to fishery resource funding in the region. Although Florida and Virginia were not members of the commission at the beginning, they were included in 1976. Funding for all projects has averaged about one million dollars annually. Most projects are not marine oriented. The seafood port feasibility and study projects have stimulated great interest in the panhandle of Florida for establishing new and modern seafood ports. At least two (one in Port St. Joe and one in Carabelle) currently are under further review. Another project is the pilot oyster fattening project conducted in Franklin

County. The Department of Natural Resources developed an oyster-fattening method that showed economic potential, but they were unable to carry the project beyond the laboratory stage. The Coastal Plains Regional Development Commission, working with a private contractor, used State developed information about oysters and set up a pilot plant to determine the economic feasibility of a commercial oyster fattening operation. Thin, spawned out, late summer oysters were fattened in the laboratory for about two weeks. A quality oyster was produced that equalled those caught in estuaries during the best growing season. This operation was discontinued because funds for the Coastal Plains Regional Commission and the Title V Commissions, were withdrawn and the Commissions were closed on September 30, 1981.

Funds for marine resource development also are available from Saltonstall-Kennedy funds (SK) that are derived from an excise tax on imported seafood products. In past years, these funds have been used sparingly, but recently some funds were released to aid seafood marketing and other industry oriented programs.

Another major Federal program affecting marine resources is the National Sea Grant Program. In Florida, this program is based at the University of Florida in Gainesville, but the funds and projects are a part of a consortium of state and private universities, each applying for funds to do marine research. The programs in Florida have been highly successful, particularly in fishery economics. The Florida program also has established a statewide network of marine extension agents designed to help fishermen, as county agricultural agents help farming interests.

The Coastal Zone Management Act (CZMA) of 1976 also is a potential source of Federal funds that may be used in a variety of ways to benefit living coastal resources. One example is the Apalachicola Bay Estuarine Sanctuary. Funds were used there to purchase additional lands for protecting the natural environment and to support a sanctuary headquarters for three years. These lands, when purchased, will be added to several thousand acres already purchased by the State for the same purpose.

In addition to the direct funds mentioned above, other Federal monies may benefit the fishing industry, even though the benefits are secondary. These include endangered species projects and studies on marine species or habitats. Sometimes the National Science Foundation issues grants for fishery and coastal environmental studies.

REGULATORY PROBLEMS

Florida's marine fishery resources currently are regulated by the State legislature. The Florida Department of Natural Resources (DNR) has rule-making authority, but only to clarify the legislation and establish ways and means of enforcing regulations not specifically outlined by law. The advantage of a legislated regulatory authority is that any new law requires approval by the House and Senate and the governor. This procedure relieves political pressure on the DNR and helps it to avoid making long-term decisions in the heat of a confrontation. The disadvantage is that it does not always work that way. Far too many laws still are enacted in the heat of controversy and many are controversial and ineffective.

In summary, resource laws should be based on the resource needs, not on the votes of any special interest groups. This requires good biological judgment and data and an ability to avoid the power of pressure politics. Florida's law says that the marine resources are to be managed for the benefit of all citizens. That should include sport fishermen, commercial fishermen, and seafood consumers alike. When the resource is shown scientifically to be in jeopardy, then all resource users should share the burden of restoring the resource. The Seven National Standards quoted earlier represent the Federal attempt to ensure these rights to all fishermen in the FCZ; perhaps Florida needs a national "Standards" for State legislation as well.

Florida also has "local laws". These laws that govern fisheries may apply only to one county or legislator's district and are not always consistent with other laws, even those based on sound biological principles or evidence. Partly in response to this problem, the Florida Legislature passed an act in 1980 that established a Saltwater Study and Advisory Council to review all fishery management needs and problems and to establish criteria and guidelines for such management. The work of the council is extremely important to the citizens of Florida and the results of their months of work were completed in 1982.

INDUSTRY CONCERNS

Some rather serious problems confront the fishing industry. The cost of fuel is causing serious concern. The scarcity and high cost of fuel is a continuing consideration among fishermen. Although expensive, current supplies of fuel are fully adequate but an allocation system may be necessary in the future. Currently, most fishermen feel they will be given preference for fuel on the same basis as farmers; this has relieved some concern. Gasoline and sales tax exemptions and fuel allocation procedures, as a relief for commercial fishermen, was reported by Cato (1973).

Direct Federal assistance to members of the fishing industry has been small although general assistance such as the use of Saltonstall-Kenndy (SK) funds for marketing programs has proven to be helpful. The most recent example of Federal assistance to the fishing industry was the aid made available to members of the oyster industry when Bahamian waters were closed to U.S. fishermen.

Some Federal assistance is also available through the Small Business Administration (SBA) and other similar agencies for low cost loans. These are loans, however, and must be paid back with interest. The advantage of such loans is their availability and lower interest rates.

The licensing of commercial fishermen currently is not required in Florida, despite six years of effort by commercial fishing organizations to pass self-licensing regulations. Such a license system would better identify permanent and seasonal commercial fishermen, and would provide revenue that might be directed toward the solution of fishing industry problems.

QUALITY CONTROL AND MARKETING

Quality control is a serious concern of the industry and increasingly strict regulations designed to protect the public health add to the cost of seafood products. Although quality control codes generally are enforced by several state or Federal agencies, enforcement is often inadequate. Some of the more progressive fishery companies employ their own quality control standards to assure safe and high quality products.

Although Florida boasts some of the largest and most modern seafood plants in the southeastern United States, a large portion of the fishing industry depends upon small fishing operations. To increase fish production and to extend the markets for under-utilized species, an extensive marketing-consumer promotion is required that is beyond the capacity of most members of the industry. To meet this need, the State of Florida has established a seafood marketing-extension program supported by the industry, Federal matching money, and State revenues. This program emphasizes under-utilized species. The development of new species or products in the market may provide the following benefits: (1) the new fishery will tend to take the pressure off traditional fisheries, especially those that are heavily fished; (2) the fish will sell at a lower price; and (3) more people will be hired in the fishing industry. One of the best examples is rock shrimp. Prior to an extensive marketing and educational program, rock shrimp in the catches usually were discarded. Now rock shrimp support a multimillion dollar fishery.

Marketing successes in Florida led to the establishment of out-of-state offices funded by the seafood marketing and extension program, and additional funds or assistance from Coastal Plains Regional Commission, National Marine Fisheries Service, and the Gulf and South Atlantic Fishery Development Foundation. Their cooperative actions also have supported extensive seafood promotion in the midwest. Most recently, international marketing of Florida and southeastern U.S. seafood products have been highly successful and may possibly lead to the establishment of a cooperative European office under the auspices of some state or Federal agency.

Limited Entry

The production of some fish and shellfish appears to be at or near maximum sustained yield and has been for many years, but rapidly rising prices have stimulated increasing competition for fish and individual catches and profits have declined. In most fisheries, there are more fishing vessels and fishermen than are actually needed for optimum or maximum production. Because of this excess, the idea of limited entry is receiving extensive discussion in Florida and already has been initiated in some states.

Limited entry is defined as limiting the number of fishermen or fishing boats in a fishery. The object is to conserve fish stocks, increase the income of individual fishermen, and possibly reduce market prices. The only limited entry in Florida is directed toward eventual elimination of the food shrimp fishery in the St. Johns River. Food shrimp production is illegal there without a permit, and only those holding permits can renew them. Since permits are invalidated when the holder dies or discontinues fishing, the number of permits eventually will decline to zero. So far the number of permits has declined from about 650 to about 130.

The lobster fishery is being considered for limited entry. The Rosenstiel Institute of Marine and Atmospheric Science of the University of Miami in co-operation with the Florida Department of Natural Resources, under a Ford Foundation Grant, evaluated economic advantages and disadvantages of limited entry for lobsters. The study did not recommend limited entry.

Limited entry sometimes can best be justified when the abundance of the resource is diminished by excessive fishing. Limited entry for economic reasons (i.e., to increase the profits of the fishermen) is not generally highly regarded. Number 5 of the Seven National Standards under PL 94-265 for the Fishery Management Plans in the Fishery Conservation Zone is a serious obstacle to economic allocation. Reluctance is expressed by those who believe that the free enterprise system will solve the problem because if the catch is divided among more and more fishermen and their profits decline, some will eventually leave the industry (intentionally or thorugh bankruptcy). The best fishermen will survive and profit. If this happens before the population is seriously depleted, a "limited entry" will have been achieved without government control. This condition is only a temporary advantage because as soon as the fishery becomes profitable again, more vessels will start fishing and the cycle is repeated. For example, recent studies by economists Cato and Prochaska of the University of Florida, have shown that for every 10 cent increase in the price of a pound of shrimp, approximately 200 more boats enter the fishery.

Limited entry workshops were held in Denver, Colorado, in 1978 and Jacksonville, Florida, in June 1981. In general, those conferences concluded that limited entry was but one tool for fisheries management and that although there might be instances where its use would be appropriate and effective, it is not a panacea and it would probably best serve as a last consideration.

Another concern of the fishing industry is the competition between sport fishermen (particularly those who sell their catch) and commercial fishermen (particularly those with larger and more sophisticated equipment) for the same stock of fish. For some species, the sport catch often equals or exceeds that of the commercial fishermen (e.g., king mackerel and speckled trout). The competition is greatest in bays and estuaries where small boats are seaworthy. Because of the political influence of sport fishing interests, commercial fishing has been eliminated or severely restricted in some areas. Some commercial fishermen fear that if this trend continues, the effect could be to slowly legislate commercial fishermen out of the business in nearshore coastal waters and estuaries. To avoid this, the commercial fishing lobby is strengthening its position on these matters.

The conflict between sport and commercial fishing is unfortunate because they share common problems (lower catches) for the same reasons (loss of natural habitat and consequent reduction in abundance). A concerted effort by both groups, directed at the real problems would be more effective.

DATA GAPS

Despite decades of scientific research on marine and estuarine-dependent fishes, detailed information on the life history, abundance, and distribution

of many species is relatively scarce. Although there are many data gaps on how fish species live and interact with each other and their environment, the major data gap is the lack of reliable sport and commercial catch statistics. Commercial landings statistics gathered by the National Marine Fisheries Service are helpful, but the data generally are insufficient for the needs of today's fishing management requirements. Reliable or useful data on sport fish catches is virtually nonexistent. Nationwide sport fishing surveys by the National Marine Fisheries Service provide about the only data available. Reliable and timely catch statistics for fishing mortality analysis must be available before some of the more basic fishery management questions can be answered.

Although Federal and some State funds have been provided for sport fishing surveys (Florida in 1980 contributed $100,000 to the National Marine Fisheries Service to increase the number of Florida interviews in an effort to achieve better accuracy), their continued funding is also in question because of fiscal constraints. Some surveys such as mail questionnaires, are subject to major, innate weaknesses, such as reliance upon information "remembered" by fishermen. These mail surveys are complex and difficult because the total population is sampled rather than only fishermen. A sport fisherman list is possible only if the fishermen are licensed. The best technique may be to count and interview during or just after fishing.

Because of the critical need for catch statistics and the scarcity of funds for such surveys, licensing of sport and commercial fishing may be considered. Proponents say that a sport and commercial license would at least identify all the fishermen (making surveys more efficient), and provide a roster that could be used in fishermen surveys. Opponents simply feel it is another unnecessary tax. The commercial license has been strongly supported in Florida by the commercial industry for several years, but it has been extremely controversial despite the three major national recreational fishery organizations that are strongly in favor of it. A general feeling in the State and Federal Governments is that the resource users should bear the brunt of costs related to that resource. As governmental funds begin to decline, the public attitudes toward a sport license may change as well. A proper license would be inexpensive, yet it would provide funds and information long needed for effective marine resource management.

Coastal habitat is necessary for producing marine resources, yet we know little of how much there is, how much has been altered, and how much of that remaining has been adversely affected by man's alterations or threatened by it. This deficiency is a major data gap. Documentation of habitat loss will be time consuming and expensive. Satellite imagery is a relatively new tool, but one which can, by comparing old and new aerial photographs, identify habitat change. This information will be beneficial in documenting not only the importance of habitats in general, but also in evaluating any new or proposed action that will result in habitat loss or alteration. It may identify areas where restoration will be most beneficial.

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MULTIPLE-USE CONFLICTS

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INTRODUCTION

Northwest Florida, consisting of seven coastal counties, is well known for its beautiful sandy beaches, barrier islands, estuaries, and coastal wetlands. As the population continues to grow (Table 1), especially along the coast, socioeconomic and environmental conflicts will become increasingly troublesome because of the growing demands of urban, residential, industrial, and recreational interests.

In view of these conflicts, Florida's natural coastal resources must be managed and protected through long-term planning to help minimize serious conflicts, alterations, or losses. It is a paradox that the very people attracted to the region, partly because of its natural resources and environmental characteristics, impose demands on water resources that could cause excessive pollution, displacement, and other environmental damage.

This paper focuses on conflicts that arise from competing uses for land and water resources. It gives a brief history of land development in the State and in Northwest Florida and discusses some of the current multiple-use conflicts. An overview of legal and institutional factors related to development is given, and a major section is devoted to environmental and socioeconomic conflicts on the Apalachicola River and Bay, Panama City Beaches, St. George Island, and Escambia Bay. Also included is a discussion of potential conflicts related to offshore oil and gas development.

Table 1. Population of the counties of Northwest Florida from 1950 to 1980 (Florida Statistical Abstract 1980).

County	Population			
	1950	1960	1970	1980
Bay	42,689	67,131	75,283	97,740
Escambia	112,706	173,829	205,334	233,794
Franklin	5,814	6,576	7,065	7,661
Gulf	7,460	9,937	10,096	10,658
Okaloosa	27,533	61,175	88,187	109,920
Santa Rosa	18,554	29,547	37,741	55,988
Walton	14,725	15,576	16,087	21,300
Region	229,481	363,771	439,793	537,061
Florida	2,771,305	4,951,560	6,791,418	9,739,992

BASIS FOR CONFLICT

The following is a list of socioeconomic and environmental problems and conflicts common to Northwest Florida. The list includes a variety of uses, all of which can result in conflict.

- o Residential, commercial, and industrial developments compete for valuable coastal lands and waters. The intensity of the demand and competition among these uses, and the concerns of environmentalists, are the basis for multiple-use conflicts in Northwest Florida.

- o New and expanding coastal residential and commercial development will further compound the problem of rapidly diminishing coastal land and water resources.

- o Coastal wetlands and estuaries are a vital link in Florida's vast commercial and sport fishing industries, but they are often disregarded by planners and developers.

- o Residential areas are frequently developed and constructed with little regard for potential hurricanes and associated floods.

- o The economy of Northwest Florida is heavily dependent upon tourism and the natural beauty of the water and beaches. Any threat to these resources is a threat to the economy of Northwest Florida.

- o Excessive use of groundwater supplies for municipal use or by individuals may cause saltwater intrusion as well as shortages of fresh water.

- o The construction of housing, roads, bridges, and jetties on barrier islands is likely to destablize the beach and dune environments.

- o Sewage disposal in new residential areas may cause serious health and environmental problems. Faulty septic tank systems could cause seepage of contaminated wastes into ground water and some coastal waters.

- o Potential Outer Continental Shelf (OCS) oil and gas development could alter priorities in development and threaten wetlands along the Northwest Florida coast.

- o Expanded upland and nearshore oil and gas development could have significant socioeconomic as well as environmental impacts.

- o Oil and gas pipelines and other related structures built on wetlands would increase open water areas, destroy emergent vegetation, increase sedimentation and turbidity, and cause serious concern for the disposition of the spoil.

- o Water may be polluted by dredge and fill practices, offshore construction of platforms, and discharges of clays and drilling liquids and wastes during drilling.

- o Pollutants discharged by industry may endanger aquatic organisms and human health.

- o Extensive new industrial developments may cause fiscal problems for local governments. During early phases of construction and operation, local tax deficits may occur because of increased population and demand for public service prior to any increase in property tax revenue. In the long run, economic gains from increased property tax revenues are likely to more than compensate for any early financial deficits.

GENERAL RESOURCE CHARACTERISTICS

Although Northwest Florida is rich in natural resources and provides numerous environmental, economic, and social benefits, its bays, estuaries, wetlands, and beaches are subject to intense urban development and growth. Good living and recreational benefits are dependent upon freshwater recharge of the wetlands, maintenance of high water quality and biological productivity, storm protection, flood control, and mineral resources.

COASTAL ESTUARIES AND WETLANDS

Coastal freshwater rivers and levees serve as a reservoir to store water, to recharge groundwater aquifers, and to provide a hydrostatic head that protects groundwater supplies from saltwater intrusion. Freshwater inflow regulates the salinity balance in the productive coastal estuarine systems.

Brackish emergent wetlands function as natural water filters. They help maintain water quality and reduce the adverse effects of urban and agricultural runoff on coastal waters and they are particularly efficient in absorbing and filtering out sediments, particulates, nutrients, and organic materials. Filtering helps build and maintain highly productive estuarine systems -- systems that provide breeding and nursery grounds and food supplies for a vast array of fish and wildlife. The majority of the income from Florida Gulf fisheries is from estuarine dependent species; consequently, maintaining the quality of wetlands, estuaries, and nearshore waters is of high priority.

Coastal wetlands provide a buffer against storm surge and flood waters by dissipating wave energy and storing flood waters. Barrier islands also serve as natural buffers, protecting mainland areas from the full force of storms.

RECREATION, TOURISM, AND INDUSTRY

The recreational value of Northwest Florida is of considerable economic and social importance to the region and the State. Tourism is the leading industry in Florida, and the coast of Northwest Florida is a major tourist attraction in all but the coldest months. Tourism is important because it supports considerable commercial and economic development.

Coastal waters and major tributaries provide routes for the waterborne transportation of goods and supplies such as oil and agricultural products, and provides sites for ports and harbors. The coast is the primary site for large electrical generating facilities and in some areas supplies an abundance of sand and gravel, shell, and oil and gas. It also is the locus of some large manufacturing industries.

OCS OIL AND GAS DEVELOPMENT

Offshore oil and gas development, deepwater ports, processing and shipping of petroleum products, and other OCS-related activities potentially could have major environmental, economic, and social impacts on Northwest Florida's coastal wetlands, natural resources, and communities. A major environmental threat is the potential for oil spills during drilling for or transporting of oil. A major oil spill could be devastating because of the coast's vulnerable environment and its heavy reliance on its beaches for tourism. Intensive OCS exploration and development generates considerable onshore activity which is accompanied by environmental, economic, and social impacts that can be either beneficial or detrimental. Some of the more significant impacts of OCS oil and gas operations are given in the following subsections:

Environmental Implications

Oil released in coastal waters in any large quantity could seriously damage wetlands and foul beaches, shellfish, and waterfowl. Coastal waters could be polluted by dredge and fill operations and by offshore construction of platforms, drilling wastes, and runoff and emissions from onshore facilities. Onshore support facilities, transportation facilities, and pipeline construction are threats to wetlands.

Economic Implications

The region's economy is heavily dependent on tourism and the beauty of the water and beaches. Any OCS-related activity that threatens these resources threatens the economy of the region.

In some areas, onshore OCS oil and gas related development could cause fiscal problems for local governments. During onshore development, local governments may be threatened by tax deficits created by the increased demand for services before any increase in property tax revenue. Despite this problem, long-term economic gains from increased property tax revenues are likely to occur.

Major economic benefits may accrue from increased community growth and employment, but if new industries supplant old ones, such as the tourist industry, there may be little or no net gain.

Social Implications

Large scale OCS oil and gas development can alter the social characteristics of rural, retirement, or tourist oriented communities. Development may change the economic base of a community and, in turn, alter its social structure. Because of the new industry and population increase, additional schools, roads, and services will be required.

Social and economic problems are the heart of multiple-use conflicts. Florida's past experience has shown that the allocation of land and water resources often provides short-term economic benefits to a few, and long-term losses to the public as a whole. In recent years, the State has recognized that large, major water-related coastal projects often have major adverse environmental effects and it has developed several mechanisms to minimize these effects (which will be discussed later in this chapter). The ongoing, rapid development of the State, however, and the increasing urban, suburban, and recreational development of Northwest Florida continue to create conflicts among the many competing uses for its land and water resources.

ECONOMIC DEVELOPMENT AND COMPETITION FOR LAND AND WATER

LAND AND WATER DEVELOPMENT

Historical Background

Florida, acquired by the United States Government from Spain in 1821, was granted statehood in 1845 when its population was about 55,000. With statehood, Florida received title to very little land, only 202,340 ha (500,000 acres) for internal improvement purposes, and one section (259 ha or 640 acres) in every township for education purposes. The State did, however, become owner and trustee of all navigable waters. It was not until 1850 that the State gained title to 8.3 million ha (20.5 million acres) of swamp and overflow land. The remaining land stayed in Federal ownership or was conveyed directly to individuals by the Federal Government.

An early goal of the State and the Internal Improvement Board (created in 1851) was to encourage internal improvement. The primary tool for achieving this goal was by disposing of land, its most plentiful commodity. In the late 1800's the railroads received approximately one-third of the State's land (11 million acres) in exchange for laying 1,100 miles of track, an average of 10,000 acres/mi of track (Landers 1975).

Swamp and overflow land also was similarly disposed of by the State. By the end of the Civil War, several railroad companies that had built lines into Florida were bankrupt or otherwise disbanded and their property reverted to the State. The Internal Improvement Board suffered financial hardship as a result and was forced into receivership. The State, in order to solve the public lands crisis, sold four million acres of southwest Florida land to Hamilton Disston, a Philadelphia sawmaker, for one million dollars (25 cents per acre).

In the latter half of the 19th century, Florida remained largely untouched and out of the way of national development. The land was inexpensive, but it also was swampy and poorly served by transportation. By 1900, the population was about half a million, most of whom lived in the northern part.

Shortly after the beginning of the 20th century, developers started filling submerged land, especially in the southern part of the State. The State immediately began disposing of its submerged land and the rush of development that began then shows no signs of subsiding today. In the past few years,

Northwest Florida has begun to experience the type of coastal development so common to south Florida.

Population Growth

The population of Florida grew from 55,000 in 1845 to almost 10 million in 1980. It continued to increase statewide at an average rate of about 7,000 people per week. A major part of this growth can be attributed to migration from other States. Because of this growth sand dunes have been leveled, bays have been polluted, estuaries have been dredged and filled, rivers have been channelized, and the State has increasingly had to cope with the multiple-use problems of development. A recent feature article in Sports Illustrated (January 1981) has gained some notoriety in Tallahassee and the rest of the State. The title of the article "There's Trouble in Paradise," gives an indication of its tone. According to the authors "in no state is the environment being wrecked faster and on a larger scale" (Boyle and Mechem 1981). Although the article is largely an editorial statement and subject to dispute, it does emphasize the problems confronting Florida as a result of development and illustrates many types of multiple-use conflicts that are associated with development, particularly those related to population growth.

Eglin Air Force Base

A number of major developments have taken place in Northwest Florida over the past several decades. By far, the largest development was the Eglin Air Force Base. The base was started in 1935 with the establishment of the Valparaiso Gunnery Range on 55 ha (137 acres) of land. Today, Eglin is one of the world's largest military bases with 187,800 ha (725 mi^2) of land spread over Santa Rosa, Okaloosa, and Walton Counties. It employs about 7,000 Department of Defense (DOD) personnel and about 3,300 non-DOD personnel. The base is the single largest employer in the region (Dames and Moore, Inc. 1980).

Panama City

One of the most apparent coastal developments in Northwest Florida is the growth of Panama City as a major tourist center. Numerous motels and hotels have sprung up along the beach in recent years, together with condominiums, restaurants, recreation facilities, and other tourist attractions. While attempting to appeal to the tourist trade, the area has undergone substantial beach erosion and is the site of a major beach nourishment project by the Corps of Engineers.

Principal Concerns

Industry, especially in Escambia County, plays an important economic role in the region, much of it in conflict with the environment. For example, many industrial plants in the Escambia River and Bay are causing severe water quality problems (which are discussed later in this chapter). The St. Joe Paper Company in Gulf County has been the source of considerable air and water pollution.

In all, the greatest land development problems currently concern residential development in coastal areas such as on St. George Island and in the

vicinity of Fort Walton Beach in Okaloosa County. The continuing encroachment of these developments on steadily diminishing coastal wetlands and beaches has generated much controversy.

Water supply is gradually becoming an important concern in Northwest Florida. Although water generally is still plentiful in the region, saltwater intrusion is developing into a major threat. For example, cones of depression have formed in the aquifer around Fort Walton Beach and in an area of southeastern Walton County as a result of heavy pumping for public water supply and irrigation. Water supply sources and distribution in Escambia, Santa Rosa, Okaloosa, and Walton Counties are the topic of a study currently being conducted by the Northwest Florida Water Management District.

Beach erosion is a natural process that is affecting much of the gulf coast. It causes economic loss because of severe physical damage to residential and commercial structures, roads, and recreational beaches. Although beach and shoreline erosion is a natural process, it has been accelerated by residential and urban development. Erosion problems in Northwest Florida are summarized in Table 2.

Table 2. Miles of beach erosion in Northwest Florida (Florida Department of Environmental Regulation 1980).

County	Beach length	Critical erosion[a]	Noncritical erosion[b]	No erosion
Franklin	54.6	18.3	30.3	6.0
Gulf	26.4	6.4	11.6	8.4
Bay	44.6	21.5	17.3	5.8
Walton	25.2	0.0	25.4	0.0
Okaloosa	24.5	0.0	14.2	10.3
Santa Rosa	3.1	0.0	3.1	0.0
Escambia	40.8	3.0	37.8	0.0

[a]Critical erosion applies to developed shoreline areas where buildings and public facilities may be threatened by beach erosion.

[b]Non-critical erosion applies to relatively undeveloped areas.

The brief overview of current issues in this section highlights the more pressing concerns currently being encountered in the region. Among other issues that are beginning to emerge is the potential for drilling for natural gas in East Bay near Pensacola, and significant port development for coal shipments at Port St. Joe. New issues will continue to emerge even as old ones are being debated and resolved. In an attempt to cope with these issues, an extensive legal and institutional framework has developed at all levels of government.

LEGAL AND INSTITUTIONAL FACTORS

This section is an overview of the State's coastal management programs. They are the Environmental Land and Water Management Act, particularly the sections on Developments of Regional Impact, and Areas of Critical State Concern; industrial siting and environmental permit regulations that affect industry, and the Coastal Construction Control Line Program. A more thorough discussion of environmental legislation is in the chapter on "Environmental Issues and Regulations."

COASTAL ZONE MANAGEMENT PROGRAM

The Coastal Zone Management Act of 1972 (PL 92-583) was adopted by the U.S. Congress as a means of protecting and enhancing the Nation's coasts by providing assistance to the States to develop and implement programs for managing their coastal areas. Florida has grants for developing its management program and is now at the stage of finalizing its program (Florida Department of Environmental Regulation 1980).

Florida's coastal zone management program dates back to 1970 when the Coastal Coordinating Council was established. The council members and staff worked with coastal planning until 1976 when the council was abolished by the legislature and its duties and functions were transferred to the Department of Natural Resources. Among the notable works by the council staff was the preparation of a massive coastal atlas and the identification of coastal lands suitable for either habitat preservation, fish and wildlife conservation, or residential and urban development (Florida Coastal Coordinating Council 1974).

In 1977, the legislature transferred the powers and duties of coastal management to the Department of Environmental Regulation. The legislature acted to strengthen coastal management in 1978 with passage of the Florida Coastal Management Act (ch. 380.19 F.S.). The enabling legislation states that "... the environmental aspects of the coastal areas of this state have attracted a high percentage of permanent population and visitors and that this concentration of people and their requirements has had a serious impact on the natural surroundings."

The Coastal Zone Management Program developed over the past two years attempts to provide more guidance and predictability to the private sector and emphasizes the strengthening of the enforcement of existing State laws. These laws can be very effective in regulating coastal development. The program also seeks to reduce unnecessary legal and administrative procedures and identify gaps in existing laws and regulations. The program also looks toward obtaining increased control for the State over Federal actions by way of the Federal consistency clause of the Coastal Zone Management Act.

The final environmental impact statement for the Florida Coastal Management Program was completed in April 1981. The Program received final approval by the Federal Office of Coastal Zone Management in June 1981.

Because the Florida legislature has directed that the Coastal Management Program be based on existing laws and regulations, the entire State has been

designated as the coastal zone because most of the existing laws are of statewide applicability. Of particular interest regarding multiple-use conflicts is the section of the program dealing with coastal development issues and the appendices on energy facilities planning and coastal shorefront areas (Florida Department of Environmental Regulation 1980).

DEVELOPMENTS OF REGIONAL IMPACT

The Florida Environmental Land and Management Act of 1972 includes provisions to involve the State in controlling land development under the Act. Developments of regional impact (DRI) are subject to a review process. A "development of regional impact" is defined as:

> Any development which, because of its character, magnitude, or location, would have a substantial effect upon the health, safety, or welfare of citizens of more than one county [380.06 (1, F.S.)].

Developments presumed to be of regional impact were adopted as Ch. 22f-2 of the Florida Administrative Code and includes twelve different types of development. Determination of their classification as DRI's depends primarily on the size of the development. Although the rule creates a presumption, projects not on the list or not meeting threshold criteria may still be determined to be DRI's if sufficient facts regarding the project support the statutory definition.

Briefly, and in broad terms, a developer proposing a project that is determined to be a DRI must file an application for development approval with the local government having jurisdiction. The report must determine what effect the development will have on the environment and natural resources of the region and whether it will unduly burden water, sewer, solid waste, or other needed public facilities, affect housing, or create additional demand for energy [380.06(8) F.S.].

Clearly the requirements of the DRI process force local governments and regional planning agencies to address multiple-use conflicts relating to a proposed project. The process highlights conflicts between the DRI and natural systems and between the DRI and manmade systems. In most instances, the conflicts can be minimized and the DRI encourages the reduction of negative impacts. Occasionally a project will be rejected in the DRI process because of major conflicts that cannot be resolved. No project has ever been rejected by the DRI process in Northwest Florida to date, but projects have been modified by the process. The major limitation of the DRI process in regard to multiple-use conflicts is that it is restricted to large projects having major impacts.

AREAS OF CRITICAL STATE CONCERN

The second major provision of the Environmental Land and Water Management Act relates to "Areas of Critical State Concern" (ACSC). The act authorizes the designation of the following three types of areas as ACSC's:

(1) An area containing or having a significant impact upon environmental or natural resources of regional or statewide importance, including, but not limited to, State or Federal parks, forests, wildlife refuges, wilderness areas, aquatic preserves, major rivers and estuaries, State environmentally endangered lands, outstanding Florida waters and aquifer recharge areas, and the uncontrolled private or public development of which could cause substantial deterioration of such resources.

(2) An area containing, or having significant impact upon, historical or archaeological resources, sites, or statutorily defined historic or archaeological districts. The private or public development of which could cause substantial deterioration or complete loss of such resources, sites, or districts.

(3) An area having a significant impact upon, or being significantly impacted by, an existing or proposed major public facility or other area of major public investment including, but not limited to, highways, ports, airports, energy facilities and water management projects [380.05 (2)(a), (b) and (c), F.S.].

The procedure for designating an ACSC is detailed and lengthy and requires substantial preliminary analysis. As part of designating an ACSC, a set of development principles applicable to the area must be prepared. Thereafter, any developments taking place within the critical area must be in conformance with the development principles. The main thrust of the ACSC provision of the Act is to protect certain important resources of the State from uncontrolled development. To date, the three ACSC's in Florida that have been so designated by the legislation are the Big Cypress Swamp Area, the Green Swamp Area, and the Florida Keys Area.

INDUSTRIAL PERMITS

Industrial development, including power plant siting, often conflicts with other land and water uses such as housing, recreation, and conservation. These conflicts are especially pronounced in coastal areas where competition for land is intense. Industry is a necessary concomitant of economic development, however, and provisions must be made to accommodate it at suitable locations. The processes involved for industry to comply with Florida's environmental and siting laws have been onerous and frequently in a state of disarray, prompting the enactment in 1979 of a streamlined Industrial Siting Act (ch. 288 F.S.). The act was passed in response to a desire to attract to Florida new industry that is consistent with the protection of the State's natural resources and environment.

A "Catalogue of Regulatory Procedures" was prepared by the State in response to the confusion surrounding the State's multiple regulatory programs (Florida Department of Administration 1979). Among the regulations covered in the catalogue are those that deal with environmental issues and industry.

This process of meeting numerous regulations for the issuance of industrial permits is commonly referred to as the "old method," with the "new method" referring to Florida's newly enacted (1979) "Florida Industrial Siting

Act" (ch. 79-147, Laws of Florida). Neither process supersedes the other. Instead, industries are given an option by the State to select which permit method they choose to follow. The major difference between these two procedures is the time and cost for obtaining a permit.

Of the 17 permit programs outlined in the catalogue, 12 apply to the procedural methods for setting industrial permits. They include permits for the following: dredge and fill, water quality, solid waste disposal, air quality, water well use and drilling, public and private water supplies, power plant construction, coastal construction setback, mined lands reclamations, open burning, and protection of historic sites and properties.

The new process is designed to take seven months from application to final decision. Should any delays be requested, the hearing officer in charge of that particular request will determine the validity of the request in deciding whether to grant the delay. The Siting Act is also designed for the applicant to submit all requests for permits to one central office, the Department of Environmental Regulation (DER), which is the fastest way to obtain the necessary permits. This causes the Siting Act to be commonly known as "One-Stop Permitting."

These two elements reflecting the time schedule differ considerably with the "old method." Although the old method denotes certain schedule completion requirements, the overall process often took up to several years for an industry to obtain all the desired permits. This was primarily due to the requirement that applicants submit requests for permits to several different State agencies and wait for each individual permit process to be completed. Sometimes, one permit process had to be completed before another permit could be requested.

Cost is another difference between these two optional processes. Minimal fees are requested by the old method. Depending upon the number of permits requested, the entire process would cost from $20 to approximately $200 or more. "One-Stop Permitting," on the other hand, is more expensive. Fees for this process range from $2,500 to $25,000. These fees are to be used to pay for all costs incurred during review of the application. An expenditure and balance statement is given to the applicant. These fees are determined during a pre-application process and vary according to the number of permits that are requested by a particular industry.

The siting of power plants with a generating capacity of 50 megawatts (MW) or more is regulated by the Florida Electrical Power Plant Siting Act (ch. 403 F.S.). The Act was originally passed in 1973 to deal with the many environmental impacts of electrical generating facilities. Siting licenses are issued by the governor and cabinet and are the only license required under State law for the construction and operation of these facilities. The application and approval process requires extensive information on design, location, and potential impacts of a proposed power plant. Studies and reports are required from several State agencies, and hearings are conducted prior to issuance of the license.

COASTAL CONSTRUCTION CONTROL LINE

The Beach and Shore Preservation Act (ch. 161 F.S.) addresses the problem of construction along Florida's coasts. The act establishes a coastal construction setback line 50 ft landward of the mean high water line. It also provides for a coastal construction control line that supersedes the 50-ft setback line when it is established based on field studies using engineering and environmental criteria for the sandy beaches of each coastal county. Coastal construction control lines are established on an individual county basis to define beach areas where special structural design considerations are required to insure protection of the beach and dune system, upland structures, and adjacent property [ch. 161.053(1) F.S.].

After establishment of the coastal line, permits are required for any excavation and construction seaward of the line and vehicles are prohibited on dunes located seaward of the line. Permits may be granted if the State's Department of Natural Resources determines that engineering and topographical data indicate a permit is justified, or if the structure forms a part of a pre-existing line of structures seaward of the line and the pre-existing structures have not suffered unduly from erosion, or if the construction is a pier or pipeline that will not cause erosion (Florida Department of Environmental Regulation 1980).

MAJOR CONFLICTS

Several notable cases of multiple-use conflicts are apparent in Northwest Florida. As the region has grown, major development has led to conflicts among various interest groups ranging from those who would preserve the existing coastal environmental to those who would have urban development to the maximum extent possible.

Four major environmental conflicts in Northwest Florida over the past quarter century are discussed in the following subsections. They are navigation in Apalachicola River and Bay, housing construction on barrier islands, excessive erosion of beaches, and pollution of Escambia Bay. A brief summary of potential conflicts from offshore oil exploration also is given.

APALACHICOLA RIVER AND BAY

Based upon volume flow, the Apalachicola River is Florida's largest river. It forms near the northern boundary of Florida at the confluence of the Chattahoochee and Flint Rivers and Spring Creek at the southwestern corner of Georgia, and it flows 172 km (107 mi) to Apalachicola Bay. The Bay is a relatively unpolluted shallow coastal estuary bounded by barrier islands. It abounds in oysters and provides about 90% of the State's total oyster production (Table 3).

Table 3. Oyster landings (lb) for Florida and Franklin County at 5-year intervals from 1950 to 1975 (U.S. Army Corps of Engineers 1980).

Year	Florida	Franklin County	Franklin County percentage of Florida production
1950	896,248	695,957	78
1955	649,581	542,874	84
1960	1,975,400	1,744,760	88
1965	2,954,745	2,377,530	80
1970	3,786,519	3,044,401	80
1975	2,213,065	2,032,065	92

The environmental conflict concerning the Apalachicola River is the navigation channel. The Corps of Engineers is authorized by the Rivers and Harbors Act of 1945, as amended, to maintain a river channel 100 ft wide by 9 ft deep, available 95% of the time on the Apalachicola River, on the Chattahoochee River to Columbus, Georgia, and on the Flint River to Bainbridge, Georgia. The Jim Woodruff Lock and Dam was completed in 1957 at the juncture of the three rivers and several smaller dams on the upper rivers were finished by 1965. Since that time, continuous dredging has been required to maintain a 9-ft channel, and even this is functional only about 75% of the time. In the early 1970's, plans were begun to build additional dams on the Apalachicola River to increase the time of functioning of the 9-ft channel to 95% of the year. This was the start of a long-running conflict between Florida interests opposing the project and Georgia and Alabama interests favoring the project.

In 1978, the Corps of Engineers proposed a dam near Blountstown, but strong opposition in Florida caused the Corps to reconsider its proposal. Currently, the Corps, together with the States of Florida, Alabama, and Georgia, is initiating a study "to help alleviate multiple-use problems of the river system so as not to have significant detrimental impacts on Apalachicola Bay" (Apalachee Regional Planning Council 1980). The proposal to the U.S. Water Resources Council is to study the inherent problems of multiple uses of the tri-river system (Apalachicola, Flint, and Chattahoochee Rivers) such as navigation, hydropower, recreation, flood control, and ecosystem maintenance, and verify that the river system must be managed as a complete and unified system (Apalachee Regional Planning Council 1980).

At one time, the Apalachicola River was proposed as an area of Critical State Concern, but this action was dropped because the pace of land development was slow, local governments were not prepared to deal with the necessary ACSC procedures, and approximately 80% of the land would be exempt because it was in agriculture or forestry. As an alternative means of control, the Apalachicola River Resource Management Plan was formulated in 1977. A committee of local and State officials representing economic and conservation interests was formed to help promote the economic development of the area

consistent with the natural resources of the area. Recently, officials of Florida, Alabama, and Georgia cooperated to obtain Federal funding for a comprehensive river basin study, but Federal budget cuts have reduced funds for this study.

The most significant response to the conflicts over the Apalachicola River was the designation of the river and bay as a National Estuarine Sanctuary under Section 315 of the Coastal Zone Management Act. The sanctuary encompasses 78,000 ha (192,750 acres) of which 54,900 ha (135,680 acres) is in existing state-owned estuarine waters and submerged lands. The wetlands associated with the river are among the most biologically productive in North America, and this productivity is a direct link to the valuable fisheries in Apalachicola Bay. The major goal of the estuarine sanctuary program is to fund research to provide the necessary information to ensure rational management of the system. Other important aspects are to enhance public awareness of the functioning and value of the system and to ensure that the ecological perspective is included in all development decisions pertaining to the river and bay (Apalachee Regional Planning Council 1980).

The features of the estuarine sanctuary program are sport and commercial fishing, hunting, nonintensive recreation, education, navigation including maintenance dredging, continuation of existing permits and spoil disposal practices until a comprehensive spoil disposal plan is developed, and continuation of the existing shellfish rehabilitation program.

Prohibited activities are the incorporation of new public works projects that require dredging or additional filling until completion and adoption of a long-term disposal plan, oil drilling, except slant drilling, from outside the sanctuary boundary, and significant alteration of flow patterns (U.S. Department of Commerce 1979).

Designation of the Apalachicola River and Bay as a National Estuarine Sanctuary was a valuable format for reducing conflicts among competing uses. There have been five sanctuaries designated in the country, two of which are in Florida.

BARRIER ISLANDS

The barrier islands in Northwest Florida that are most important to the coastal ecosystem are Santa Rosa Island, Shell Island, Crooked Island, St. Vincent Island, St. George Island, and Dog Island. Although not islands, Perdido Key and St. Joseph Spit function in much the same way. The islands range in length from 6 mi (Shell Island) to 55 mi (Santa Rosa Island). All except St. Vincent Island are no more than a half mile wide.

Barrier islands are so named because they provide a barrier for protecting lagoons, marshes, estuaries, and the mainland from the direct forces of storms and waves. The islands are constantly shifting and changing because of wind, waves, and currents. Among the several valuable functions that barrier islands perform in their natural state is their role as the first line of defense against hurricanes and major winter storms. They absorb enormous wave, wind, and tidal energy. Beaches and dunes may shift substantially as a result of these forces, sometimes growing larger by deposition, and sometimes

receding through wind and wave erosion. Although barrier islands may seem unstable for purposes of development, they are extremely stable ecologically because of their dynamic nature (LaRoe 1980). When left in its natural state, the coastal environment is not at all fragile, but is a resilient system able to withstand constant change.

When residential, commercial, and other such development is imposed on a barrier island, attempts are made to create a stable environment. Although the islands withstand stress from natural processes, they are much less able to absorb manmade stress. "In the long run, however, these systems will seek a new equilibrium which is usually accompanied by great expense to man in the form of property damage and possibly loss of life" (Apalachee Regional Planning Council 1980).

For development to take place in such a dynamic ecosystem, it is necessary to understand the form and function of the entire coastal system. In simple terms, the most rational action from an ecological perspective is to halt development on barrier islands, for their very nature is unsuitable for man's long-run objectives. The desire for residential, commercial, and recreational activity along the coast, however, make barrier islands a prime choice for development.

St. George Island, off the mouth of the Apalachicola River, is a classic barrier island. It has high aesthetic and recreational values, including its dunes, white sand beaches, and beautiful waters along its 30-mi length. Because of its size, location, and unique ecological features, the island is an important part of the Apalachicola Bay system.

Several actions have had and will continue to have profound effect on St. George Island. The first major action was to cut a channel (Sike's Cut) across the island to reduce travel time for shrimp boats in and out of the Bay. This action by the Corps of Engineers in 1954 increased the salinity in the bay, thereby reducing oyster productivity. The second action of consequence was the construction of a causeway connecting the island to the mainland, thereby opening the island to more intensive development and use. In 1977, Leisure Properties, Inc., which owns approximately 1,215 ha (3,000 acres) on the island, filed a DRI application for development approval to subdivide and develop the property for approximately 600 homesites. The firm constructed 7 mi of road and installed 15 mi of water lines and underground utilities. Over 2.5 million dollars worth of 5-acre lots were sold in 1976, and a 300,000 gal water supply reservoir was constructed. Since 1978, over 500 one-acre lots have been for sale.

In an attempt to partially counteract development on the island, the State acquired 930 ha (2,299 acres) under the Environmentally Endangered Land program for use as a State Preserve. Limited roads and recreation facilities have been built, but the main focus is to preserve the barrier island beach and dune system in its natural state.

BEACH EROSION

Northwest Florida's beaches are one of its most important economic resources. The beautiful sandy beaches attract many tourists and provide

erosion control, hurricane protection, and related purposes (U.S. Army Corps of Engineers 1976). The report was submitted in 1976 recommending a project for the 18.5-mi reach of the Panama City beaches. Although the study was authorized and initiated in the early 1970's, Hurricane Eloise (23 September 1975), which was extremely destructive in terms of erosion and property damage, reinforced the need for beach control and hurricane protection.

A beach and dune development plan was prepared as the most suitable plan for implementation. Under the plan, an artificial dune system 15 ft high and 30 ft wide would be provided, together with a beach width of 110 ft. The dune would be stabilized with vegetative cover, and the beach would need renourishment every 10 years because of continuing erosion. The estimated total first cost of the project is $19,550,000. The beneficiaries of the improvement were viewed as the numerous property owners adjacent to the shoreline and the thousands of visitors who will use the enlarged beach. The project, together with the existing beach area, "would assure continuation of beach recreation and associated development and land use patterns. Continued development would sustain high employment and good earnings along with projected increases in local population" (U.S. Army Corps of Engineers 1976).

Construction of the beach and dune restoration project was completed in 1979 despite controversy concerning the cost, design, method of construction, and potential environmental impacts of the project. Currently, the project seems to be serving its intended purpose.

Although beaches are vital to the economy and environment of Northwest Florida, substantial erosion is taking place. Some people wonder if erosion is really a problem if development and construction are kept away from the shoreline. The basic conflict seems to be between development along the beach for tourism (i.e., motels, hotels, condominimums, and beach houses), and maintaining beaches and dunes in their natural state. Because major investments already have been made along the beaches, especially at Panama City, and because these investments play an important role in the economy, it is reasonably safe to assume that economic interests will predominate over environmental interests. The adoption and enforcement of the State's coastal construction control line requirements under the "Beach and Shore Preservation Act" (ch. 161 F.S.) should play a major role in lessening future conflicts between beach erosion and development.

POLLUTION OF ESCAMBIA BAY

Pensacola Bay, collectively formed by gulf waters and the drainage of the Escambia, Blackwater, Yellow, and East Bay River basins, lies to the east and to the south of the City of Pensacola. Perdido Bay, likewise formed by the gulf waters and the contributions from the Perdido and Styz River basins, lies to the west and south of Pensacola.

Industrialization around Escambia Bay and along the Escambia River dates back to 1951 with the establishment of a plant at Pensacola Bay by the Monsanto Chemical Company. The Escambia Chemical Company and American Cyanamid Corporation also built plants on the bay (Carter 1974). As of 1980, there were six major industrial plants on or near the Bay (Table 4).

Table 4. Major industries located near water bodies in Escambia County.

Name	Location
Monsanto Chemical Co.	Escambia River
American Cyanamid Corp.	Escambia Bay
Container Corporation of America	Escambia River
Gulf Power Company	Escambia River
Air Products, Inc.	Escambia Bay
St. Regis Paper Co.	Eleven Mile Creek off Perdido Bay

Although Escambia Bay once supported a substantial oyster, scallop, and shrimp industry, the bay scallops have virtually disappeared and the oyster and shrimp production has been greatly reduced (Hopkins 1973). Urban and industrial development of the land around the Escambia Bay area are held responsible. Pollution has become so serious that numerous major fish kills have been reported.

The first well-documented ecological research on the coastal waters was undertaken in 1952 (Hopkins 1973). Since then, numerous inventories of ecological conditions have been carried out by various government and private research groups. Analysis of conditions over time reveal the trend of increasing pollution.

In keeping with practices of the day, industry disposed of its pollutants into Escambia Bay and Perdido Bay and their tributaries. Although the bays could assimilate some wastes for awhile, the increasing pollution load started to take its toll. The first incidence or complaint of pollution was in 1955 after the Chemstrand Plant (now Monsanto) started operations. These problems were compounded by the location of the Escambia Chemical Company and American Cyanamid Corporation plants on the east shore of upper Escambia Bay (Hopkins 1973). As examples for the area, there were 20 fish kills in 1969, and about 75 in 1970 and in 1971. A massive oyster kill was reported in 1971. The drastic condition of Escambia Bay led to two Federal-State water quality enforcement conferences in 1970 and 1971 by the U.S. Department of the Interior.

Industrial pollution has caused a decline in fishing success, tourism, recreation, and property values (Terrebonne 1973). There was a clear conflict between the economic gain by the industries and the losses to tourism and fishing.

Many of the industries that contributed to the above problems also contributed to air pollution in the Pensacola area. The nature of air pollutants ranged from particulates generated by wood and chemical industries, to emissions from automobiles (U.S. Army Corps of Engineers 1978).

POTENTIAL OFFSHORE OIL AND GAS DEVELOPMENT

Development of offshore oil and gas fields near Northwest Florida could have serious multiple-use conflicts onshore. Offshore oil and gas development, whether on the outer continental shelf (OCS) or nearshore, could have direct environmental impacts from the wells, particularly from a blowout, from brine discharges, and from mud discharged during the drilling process. Even more significant could be the socioeconomic and environmental impacts caused by onshore support facilities. These conflicts are discussed more fully in the chapter on "Minerals Production," but a review of exploration in Santa Rosa County is given here.

In Santa Rosa Coutny, Getty Oil proposed to drill a 17,800-ft exploratory well for gas near the center of East Bay. East Bay is an inland water arm of the Pensacola Bay estuary system. The object of the well will be to test the Jurassic Age Smackover-Norphlet formations which have produced hydrocarbons in other areas of Northwest Florida, Alabama, and the gulf coast. Natural gas is anticipated at this depth. Development of an East Bay gas field has the potential of contributing more than $27 million to the local economy and $45 million to State and local governments (Florida Department of Environmental Regulation working file).

An East Bay discovery of natural gas would provide a needed backyard supply for domestic and commercial users in Pensacola and Milton. The well would have been drilled from a self-contained bay-barge position over the anticline near the center of East Bay. If the well were found productive, a production platform with a series of high pressure valves would be installed.

Environmental damage is always a potential threat, but the "worst case" accident scenario would require the following to occur simultaneously: hydrocarbons must be present; the hydrocarbons must be in the form of crude oil rather than natural gas; and the well must have a blowout. The odds of an occurrence of just one factor, finding hydrocarbons, are about one chance in twelve. The geologic rule for wells within the Jurassic Age is that sediments of a depth greater than 17,000 ft are likely to produce natural gas rather than crude oil. For all offshore wells drilled, there is one chance in 1,250 of a blowout occurring. The probability of a find and a blowout are virtually nonexistent.

Getty Oil Company acquired leasehold rights from the State in 1968 for approximately 47,932 acres of bay bottom in East Bay, Blackwater Bay, and the portion of Escambia Bay that lies in Santa Rosa County. The first application for drilling in 1971 was turned down by the Florida Department of Natural Resources. Subsequent applications for drilling permits were alternatively granted and rejected by various State officials, the Cabinet and the legislature. One agreement required Getty to use strict pollution controls and post a $35 million bond to cover any adverse effects. The final disposition of the Getty permit application will be determined by the courts.

SUMMARY

The coastal waters and estuaries of Northwest Florida have been seriously altered by industrial, residential, and commercial developments, partly because of the lack of consideration for the integrity of the natural environment. The design of these developments has been imposed by an economic system that largely invests in uses that promise high profits rather than protection of the natural environment.

The development of institutional procedures for responding to the failures of the market system to consider environmental planning is indeed a difficult task. Enforcing regulations to control or reduce environmental damage may appear to be prohibitively expensive, but ultimately protection of the natural environment is imperative.

The trade-offs between the economy and the environment will depend on society's evaluation of the need for maintaining viable coastal and estuarine ecosystems as opposed to further residential, commercial, and industrial development. Local government zoning commissions may become instrumental in developing balances among needs. This may be especially true if offshore oil and gas finds are of such magnitude that they require onshore facilities and services.

The topic of multiple-use conflicts is broad and does not lend itself to clearly defined sets of data. Several issues addressed in this paper were based upon a limited amount of information drawn from a variety of sources. Most needed is accurate land use data that reflect the type and intensity of development, value of land, and value of improvements. Assessments of the impacts of development on the environment would be more accurate if there were better information on industrial pollution and costs for pollution control.

The subjects selected for discussion in this chapter were chosen because they were areas of special concern in Northwest Florida. The Apalachicola River, St. George Island, Panama City Beaches, East Bay, and Escambia Bay have felt the effects of various types of expanding onshore development. As a result of environmental concerns and controversies, portions of the Apalachicola River and Bay system have been designated a National Estuarine Sanctuary; portions of it are State aquatic preserves; upland areas of the river have been acquired by the State as environmentally endangered lands; and additional areas have been named for protection under the Florida Conservation and Recreation Lands program and the Save Our Rivers program. These actions were possible because of the relatively high abundance of environmental data available about the areas concerned. Environmental research in all coastal waters of Northwest Florida must be expanded to demonstrate environmental values in multiple-use conflicts.

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ENVIRONMENTAL ISSUES AND REGULATIONS

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INTRODUCTION

The economic and environmental impacts of man's alteration of natural resources are the focus of this paper. All natural resources are finite and competition for their use is universal. The tenet of economics therefore, is the study of the distribution of resources among competing users. This tenet includes the air and the seemingly boundless waters into which wastes are discharged.

Some resources such as labor, raw material, and managerial expertise have a market price associated with their use that is incorporated into the price of the product. Resources such as air and water are used in the production process and are assumed to be free. They are not, however. When wastes are released into the air or water, they frequently result in secondary, often unintended impacts or costs. Human health may be affected by sulfur oxide discharged from coal-fired boilers, or by lead poisons from industrial waste discharge. Some indirect costs (side effects) are the destruction of valuable saltwater fisheries and contamination of oysters, and intrusion of saltwater into groundwater aquifers.

Air and water pollution often causes excessive direct and indirect costs to local economies. Proper knowledge about market demand and resource values would avoid many of these external costs. In economic terms, indirect costs are not usually counted in the pricing system. Pollution is an example. Indirect costs that escape the pricing mechanism may include impaired health, lower property value, altered ecological resources, and lost recreational opportunities.

Many of the underlying economic problems related to environmental protection manifest costly side effects. For example, the "cost" of pollution to society rarely carries a price tag and is not usually considered in cost/benefit analysis.

Many indirect costs are caused by imperfections in the market system. This imperfection arises, in part, because many natural resources, such as air and water, are owned by the public rather than by private individuals.

Because they are available to society, there are few economic incentives within the private sector to include public resources in their planning.

Expenditures to clean up contamination of our environment comprise major costs that are currently receiving nationwide attention. Improper disposal of hazardous substances is not new, yet these wastes are threatening the lives and health of citizens throughout this county. Proper disposal through the years would have required high initial capital outlay, but now cleanup to correct existing dangerous situations will cost much more. For example, in North Carolina, expenditures between $2 million and $12 million might be necessary to clean up PCB, a product used in manufacturing processes, that was illegally dumped along roadsides at night as a cheap method of disposal. Proper disposal of those wastes initially would have cost only about $100,000.

More visible is the Kepone Disaster at Hopewell, VA, which could have been prevented with an initial investment of $100,000. Claims against the company presently total $420 million and it is doubtful whether the government investment of several billion dollars will suffice to clean up the James River. Perhaps the best known hazardous waste disaster is the Lovel Canal in Niagra Falls, NY. Dioxin and other chemicals seeped into nearby creeks, contaminated water supplies and caused high incidence of illiness (Council on Environmental Quality 1981). So far $36 million has been expended for cleanup there. Had the proper environmental controls been in place, an investment of approximately $2 million would have made that site secure (Roy 1979).

Pollutants entering the air and water sometimes seriously lower property values. Results of a recent survey show that Los Angeles residents are willing to pay $650 million per year, which averages about $350 per household, for a 30% improvement in air quality (Roy 1979).

High quality air and water are major factors affecting human health and comfort, and are prerequisites for tourists and retirees. Severe air pollution clearly alters the attractiveness of an area and adversely affects property values.

Many sections of the United States depend heavily upon environmental amenities (leisure and recreation) as an economic base for employment and income. In 1980, tourists contributed over $17 billion to Florida's economy. The climate and quality of Florida's unique natural environment are the principal attractions for a majority of the visitors and retirees who emigrate to Florida.

Florida's natural resources are the foundation of its economic base (Lynch 1977). For example, saltwater sport and commercial fisheries contribute substantially to the State's economy (Bell 1979). Commercial fishing supports 36,262 jobs and generates $160 million per year in final sales. In Florida, saltwater sport fisheries directly and indirectly provide 118,000 jobs and the freshwater fisheries provide 25,000 jobs. The annual user value is $1.6 billion and $493 million, respectively (Bell 1979).

Oil spills along Florida's St. Marks River are costly (the annual loss is about $329,000) because of property damage, clean-up costs and the decline in sport fishing and tourism (Bell 1980). The damage from oil spill capitalized at a 6.78% discount rate totals about $4.8 million annually.

Environmental issues must be considered in terms of social and economic ramifications. Environmental decisions have wide-ranging economic impacts and wrong decisions may cost millions of dollars to State and local economies. On the other hand, economic decisions have wide-ranging environmental impacts and the wrong decision may result in severe pollution and the alteration or loss of extensive natural resources. The continuing need for a balance between resource use (economics) and natural resource preservation requires information on environmental values (e.g. fishing) and habitat alteration such as air pollution (Lynch 1977).

PURPOSE

This synthesis paper provides a baseline assessment of the natural resource in Northwest Florida; the regulatory standards governing its resource quality, the level of resource quality, and the value of the resource as best described by national or state-specific economic research. The key linkage between the quality and the value of the resource should provide a base line measurement against which to weigh other potential competing uses.

Because of the broad scope of major environmental issues, this paper focuses largely on Northwest Florida's air and water quality problems and compliances with Federal and State pollution standards. The papers on mineral and oil production, agricultural production, and recreation and tourism relate more with the economic aspects of environmental problems. The last section of this report summarizes the major Federal and State legislation dealing with environmental matters.

SCOPE AND FORMAT OF THE SYNTHESIS

The scope of this paper is limited to a general discussion of the major environmental issues prominent in Northwest Florida and will be limited to a brief discussion of (1) the general characteristics of the major natural resources, (2) the appropriate Federal, State and local standards relevant to those resources, (3) the historic and current levels of compliance including specific circumstances regarding compliance, (4) the future forecast or trends affecting the resource, and (5) estimates of the economic values of the resources.

GENERAL CHARACTERISTICS OF NORTHWEST FLORIDA

Climate

Northwest Florida is characterized by a Gulf of Mexico climate that is generally humid and subtropical with warm summers and mild winters. Average January temperatures are in the midfifties range (°F) and frost and light freezes are infrequent and short in duration. Mean summer temperature is about 81°F; maximums sometimes reach 100°F. Air temperatures usually are in the high eighties (°F) along the coast and in the midnineties (°F) inland.

The region has a wet season in late winter and early spring because of major fronts from the northwest, and in June through August, because of warm,

moist air moving in from the Gulf of Mexico. The range of mean annual rainfall among the seven counties of Northwest Florida is 57 to 67 inches.

Physiography

Northwest Florida is part of the coastal plain, divided between the Western Highlands and the Coastal Lowlands. Their interface roughly parallels the 100-ft contour, but there are uplands ranging from 100 ft to more than 300 ft above mean sea level. The highest elevation in Florida (345 ft) is located in Walton County near the Florida-Alabama state line.

Soils

The soils of the region are about evenly divided between well-drained soils in the north and poorly drained soils along the coast (Florida General Soil Atlas).

ENVIRONMENTAL RESOURCE ISSUES

AIR QUALITY

Ambient Air Quality

The quality of the ambient air in Northwest Florida, considered to be good, is attributed to a scarcity of heavy industry.

Federal, State and Local Standards

The ambient air quality and standards for Florida are given in Table 1. Trend data described in this report are from the U.S. Environmental Protection Agency (1980) summary statistics "Inventory by Pollutant 1970-79," taken from the National Aerometric Data Bank Inventory and from the Department of Environmental Regulation (DER), Bureau of Air Quality publications.

Because of the technical nature of the following discussion it will be useful for the reader to consult Table 1 in conjunction with the text.

Historical Levels of Compliance

Particulates. A limited amount of monitoring of air particulates took place in Northwest Florida in the 1970's. Some of the results are given here. In Apalachicola, Gulf County, in 1970-73, the annual arithmetic mean of particulates ranged between 58 to 45 ug/m^3. In Gulf Breeze, Santa Rosa County, the mean fell from 51 ug/m^3 in 1973 to 40 ug/m^3 in 1979. In Panama City, Bay County, the mean fell from 44 ug/m^3 in 1975 to 41 ug/m^3 in 1979. In Pensacola, Escambia County, particulate air quality fluctuated. One site (Number 103540002) was close to or over Federal secondary and Florida primary standards. At this site in 1978, most particulates measured from 51 ug/m^3 to 65 ug/m^3, but maximum concentrations ranged from 107 to 198 ug/m^3. Concentrations measured at other stations in Pensacola were relatively low and showed no trends. In Port St. Joe, Gulf County, the arithmetic mean of particulates

Table 1. National and Florida ambient air quality standards[a]; ug/m^3 = microgram per cubic meter (Florida State Department of Environmental Regulation, Bureau of Air Quality Management April 1980).

Pollutant	Time frame	Primary standards	Secondary standards[b]	Florida standards
Particulate matter	annual (geometric mean[c])	75 ug/m^3 [c]	60 ug/m^3	60 ug/m^3
	24-hour	260 ug/m^3	150 ug/m^3	150 ug/m^3
Sulfur oxides	annual (arithmetic mean[d])	80 ug/m^3 (0.03 ppm)[e]	150 ug/m^3 (.02 ppm)	150 ug/m^3 (0.02 ppm)
	24-hour	365 ug/m^3 (0.14 ppm)	260 ug/m^3 (0.1 ppm)	260 ug/m^3 (0.1 ppm)
	3-hour[b]		1300 ug/m^3	1300 ug/m^3 (0.5 ppm)
Carbon monoxide	8-hour[b]	10 ug/m^3 (9 ppm)	(same as primary)	(same as primary)
	1-hour[b]	100 ug/m^3 (35 ppm)	(same as primary	(same as primary)
Nitrogen dixoide[f]	annual (arithmetic mean)	100 ug/m^3 (0.05 ppm)	(same as primary)	(same as primary)
Photochemical oxidants[g]	1-hour[b]	235 ug/m^3	(same as primary	160 ug/m^3 (0.08 ppm)
Hydrocarbons[h] (nonmethane)	3-hour (6 to 9 a.m.)	160 ug/m^3 (0.24 ppm)	(same as primary)	(same as primary)

[a]The air quality standards and a description of the Federal Reference Methods (FRM) were published on April 30, 1971, in 42 CFR 410, recodified to 40 CFR 50 on November 25, 1972. The new FRM for nitrogen dioxide was published on December 1, 1976, as 40 CFR 50.

[b]Not to be exceeded more than once a year.

[c]Geometric mean is a measure of central tendency. It is the nth root of the product of n individual data values recorded during the given period.

[d]Arithmetic mean is the most common measure of the central tendency. It is the sum of the data collected during the given period divided by the number of observations in the same period.

[e]Parts per million.

[f]Chemiluminescence has been established as the FRM and the sodium arsenite and trienthanolamine guiacol sulfite (TGS) methods have been identified as equivalent methods.

[g]The FRM measures O_3 (ozone).

[h]The hydrocarbon HC standard is a guide to devising State implementation plans to achieve the oxidant standard. The HC standard does not have to be met if the oxidant standard is met.

fell from 95 to 51 ug/m^3 from 1974 to 1979. The maximum subsequently fell from 277 to 123 ug/m^3. In Santa Rosa County in 1979, the arithmetic means ranged from 50 to 58 ug/m^3, which was close to the Florida primary (National secondary) maximum standard of 60 ug/m^3.

Sulfur dioxide. The only Northwest Florida counties measured for sulfur dioxide were Bay, Escambia, and Santa Rosa Counties. These measurements were taken largely to monitor industrial sources and military installations. None of the time-related readings (3-hour, 24-hour, and annual arithmetic mean standards) was approached. The annual arithmetic mean in Panama City in Bay County flucuated between 5 and 9 ug/m^3 in 1975-77. In Escambia County, the Ellyson Naval Air Station, Monsanto Chemical Co., and Montren areas were monitored, as well as several other urban and remote sites. Average annual concentrations were relatively low and no trends appeared in the 1970's. The annual average was 26 ug/m^3, well below the annual secondary standard (60 ug/m^3).

In Santa Rosa County, the maximum short-term concentration of sulfur dioxide in the air was about 1,118 ug/m^3, which was near the 1,300 ug/m^3 3-hour standard. In Santa Rosa County, the monitoring included a site at the Jay Oil Field Production and processing facility. Generally, concentrations of sulfur dioxide for both short-and long-term standards are increasing in Santa Rosa County. None, however, approach primary or secondary standards at this time. Annual arithmetic means at most stations ranged from 5 to 19 ug/m^3.

Nitrogen dixode. Limited measurements of nitrogen dioxide in Northwest Florida were taken at Panama City in Bay County, Pensacola in Escambia County, and Gulf Breeze in Santa Rosa County. The highest ambient nitrogen dioxide concentration was in Pensacola where the arithmetic mean was 16.8 ug/m^3, well below the Federal and State standard.

Future Forecasts

All indications suggest good air quality for Northwest Florida now and into the near future (Discussions with staff, Bureau of Air Quality, Florida State Department of Environmental Regulation, July 1980).

Evaluation of The Resource

Economic evaluation of side effects of air pollution. The nature and approaches used in estimating indirect economic costs or secondary impacts caused by air pollution are wide and varying. According to Waddell (1974), the costs of air pollution were about $5.5 billion for property damage, $4.3 billion for health, $1.1 billion for material damage. No estimates were made for damage to vegetation.

In another report, the annual cost of air pollution in the United States was estimated at $16.1 billion, or about $74 per person per year. These costs obviously are far greater for the elderly, the young, and the poor because of their weak socioeconomic status.

WATER QUALITY

General Characteristics of the Resource

Description of Florida's water quality classification system. Standards for all the designated classes of water within the State of Florida are Class I, drinking water with Class IA potable surface; Class IB, potable groundwater supplies for drinking water; Class II, designated as shellfish propagation waters; and Class III, fish and wildlife propagation and recreation surface water. Class III is largest and contains over 90% of the State's surface waters. With certain parameters there is also a Class III marine standard which is more appropriate for a saltwater environment. Class IV, an agricultural designation, is largely for self contained agricultural related irrigation and water retention systems. Class V is an industrial and navigational classification. Class VA is for surface waters of which there is only one in Florida and Class VB is for industrial groundwater for such uses as deepwell injection of industrial wastes.

Federal and State Standards

The specific parameters for each classification vary according to use, and are more stringent ascending from the Class V Industrial to Class I Potable sources of water. The Florida classification also includes a separate subcategory for Class V (Groundwater) which is discussed in detail later. Florida law requires each body of water to be classified according to its "highest and best use." Few reclassification requests have been made or adopted since development of the surface and groundwater standards. Most of these standards are taken from the EPA document "Quality Criteria for Water" developed by the Criteria Branch of the Criterian Standards Division within the Office of Water Planning and Standards, U.S. Environmental Protection Agency (1976). Criteria are given for (1) domestic supply, (2) fresh waters for aquatic life, (3) marine waters for aquatic life, and (4) water for irrigating crops.

Virtually all standards are based on tests of aquatic animals (including humans) with a factor of safety for each standard. For example, the lethal concentration for 50% of the given most sensitive aquatic population is termed LC50. If the concentration is 2 mg/1, then a division factor of 10 is applied and the EPA standard for an aquatic environment would therefore be 0.2 mg/1. EPA states:

> Water quality criteria are derived from scientific facts obtained from experimental observations that depict organisms responsible to define stimulus of material under identifiable or regulated environmental conditions for a specified time period. The criteria levels of domestic water supply incorporated available data for human health protection. In some instances 1/100 of a concentration of the LC50 is employed while others 1/20 or 1/10 of the LC50 level constitute a safety factor (U.S. Environmental Protection Agency 1976).

These recommendations are based on scientific and professional judgment. These standards protect the life of all Floridians and visitors and maintain the propagation of aquatic and other life forms dependent upon aquatic environments. These are, therefore, tied to the health, welfare, and well-being of all citizens of the State.

Each classification has its particular level of compliance. For Class III, freshwater standards dominate the majority of interior wetlands including creeks, rivers, lakes, swamps and other interconnected aquatic environments. Substantial differences can be expected among the wetlands in Class III because of the diversity of climate, geology, habitat, and land use. Although this classification covers a large surface area, the discussion is limited to those areas where ongoing water quality analysis data are available. A description of the major water courses in Northwest Florida and the significant water quality violations within each designated major Class III system is given in the following paragraphs.

Major Rivers

The major river basins in Northwest Florida are the Apalachicola River, the Choctawatchee River, the Pedro River which includes the Yellow River, the Blackwater River, the Escambia River, and Perdido River. Most of the data in this section are taken from the Florida State Department of Environmental Regulation 1979a, 1979b.

Streams in Northwest Florida generally are characterized by high dissolved oxygen concentrations, low to medium concentrations of nutrients, high coliform counts, low conductivity, high suspended solids, and medium chlorophyll-*a* values. The waters at Permanent Network Stations (PNS) in Northwest Florida have high levels of dissolved oxygen. Seven of the streams rank in the top ten of the 50 Florida streams examined. Biological Oxygen Demand (BOD) and nutrient concentrations are low and the BOD means rarely exceed 1.5 mg/l. Total phosphorus concentrations also are low (0.1 mg/l).

Coliform counts generally are high in most streams in Northwest Florida. The upper Choctawhatchee River has the second highest fecal coliform concentrations in the State, averaging 1,115/100 ml, but most streams average about 125/100 ml. Average count in the upper Escambia River was about 5,200/100 ml.

All streams except the Blackwater and Perdido Rivers had pH values above 6.0. The Apalachicola, Perdido, and Chipola Rivers generally exhibited the lowest coliform count and highest total organic carbon.

Turbidity and suspended solids are similar in most rivers and are highest in the upper Escambia, middle Choctawhatchee and Apalachicola Rivers. Chlorophyll-*a* concentrations average 3 to 6 ug/l throughout the area. The lower Apalachicola River had the highest concentrations.

With the exception of coliform concentrations, overall water quality in the streams of Northwest Florida is good, The Perdido, Blackwater, Apalachicola, Yellow, and Chipola Rivers exhibit the best water quality. If it were not for the high coliform counts and high concentration of suspended solids, these stream would be some of the State's cleanest. The high readings apparently are natural and are not caused by municipal or industrial wastes.

Apalachicola River. This River is formed by the confluence of the Flint and Choctawhatchee Rivers and flows into Apalachicola Bay. Recent data show an increase in total phosphorus concentrations and a decrease in nitrate-nitrite levels over the period of record. Historical data indicate a high level of fecal coliform bacteria near the headwaters of the Apalachicola River, but levels are lower toward the mouth of the river. The reverse is evident in more recent fecal coliform counts which show low levels in the upper reach of the river, and higher levels toward the bay. No overall temporal trend in water quality is evident in the Apalachicola River. Available data indicate good water quality south of the Florida-Georgia State line, although decreased dissolved oxygen (DO) and increased fecal coliform counts in recent years are of some concern. In 1977-79, violations of standards of pH, several heavy metals, and DO were observed.

Choctawhatchee River. The Choctawhatchee River originates in northern Alabama, enters Florida near Graceville, and flows about 89 mi into the Choctawhatchee Bay. A comparison of historical and 1979 data indicate increasing total phosphorus concentrations and decreasing nitrate-nitrite levels. Average DO concentrations have increased and mean pH levels have decreased in recent years. No overall temporal trend in the water quality in the Choctawhatchee River Basin is discernible. Available data indicate generally good water quality. Over the period of record to 1979 several violations were evident in pH, total alkalinity, DO, and several heavy metals; however, the violations are infrequent and do not appear to be a serious concern.

Yellow River. The Yellow River in the Perdido/Escambia River Basin originates in Covington County, AL and flows southward for approximately 92 mi emptying into the Blackwater Bay in Florida. A comparison of historical vs. recent data shows a decrease in total phosporous (TP) and nitrate-nitrite averages indicating an improvement in nutrient concentrations in the Yellow River. Dissolved oxygen concentrations and pH have decreased in recent years especially near Holly where substantial decreases have been observed. Recently, fecal coliform have increased considerably over the period of record particularly in the upper reaches. No overall change of water quality in the Yellow River is noticeable. Water quality has been generally good despite high fecal coliform bacteria counts at several localized areas.

Blackwater River. The Blackwater River is considered to be one of the cleanest rivers in Florida. It originates north of Bradley, AL and travels 58 mi to Blackwater Bay. A comparison of available historic and recent data indicates an apparent overall improvement in the water quality, especially in phosphorus, nitrate-nitrite, and DO concentrations. Few violations are evident with the exception of pH and total alkalinity concentrations near Hwy-4 northwest of Baker in Okaloosa County.

Escambia River Basin. The Escambia River flows approximate 92 mi south from the Florida-Alabama line into Escambia Bay forming the boundary between Santa Rosa and Escambia Counties. A comparison of historical and recent data indicates some improvement in water quality within the last two years. A noticeable improvement in total phosphorus and nitrate-nitrite concentrations throughout the river was observed. Improvements in macroinvertebrate diversity also were reported. Dissolved oxygen concentrations in the upper reaches of the river have increased in recent years. No obvious trends in fecal coliform concentrations in the Escambia River were found. In general, the water

quality in Escambia River and in Escambia Bay is relatively high. The river runs through the major Pensacola urban area and part of it adjoins the Pensacola Naval Air Station. In 1977-79, several water quality violations were reported for total alkalinity, cadmium, lead, pH, DO, and copper. The recent trends show some improvement.

Perdido River Basin. The Perdido River flows south from the Alabama line approximately 62 miles and empties into the Perdido Bay. Water quality in the river is relatively good. A comparison of historic and recent water quality data suggests a trend towards improvement in DO and nitrate-nitrite concentrations. Total phosphorus also has decreased in the lower reaches of the Perdido River. An apparent decrease in mean pH value throughout the river may be related to hydrologic conditions within the last two years. In 1977-79, several violations involving pH, DO, total alkalinity, and several metals were reported. These violations do not appear to be frequent enough for serious concern.

LIKELY FUTURE TRENDS

Section V of water quality assessment papers entitled "Statistical analysis of water quality vs. point and nonpoint pollution sources" is an exercise in multiple regression analysis where pollution point and nonpoint sources are statistically regressed against specific water quality criteria (Florida State Department of Environmental Regulation 1979a). Correlation coefficients were calculated between pairs of water quality parameters and pollution loading factors. The signs from the coefficients indicate whether or not they are positively or negatively related and are instructive for both current analysis of pollution loadings and levels, and future forecasts. Correlation coefficients were reported for variable pairs with statistically significant relationships at a 95% confidence level.

The analysis suggests that a better relationship exists between water quality (WQI) and watershed characteristics than one would expect. A correlation coefficient of 0.74 indicates that point source, nonpoint source, and urban centers tend to be correlated with lower water quality. The PNS watershed, which has highly concentrated pollution sources, and a low watershed index (WSI), has lower water quality, and lower WQI. The degree of scatter in the plot indicates that not all of the WQI is explained by watershed characteristics alone (Figure 1). This is reasonable given the multiple casual relationships involved.

The report also develops a water quality index and a WSI that demonstrates the relationships among changes in standard values of all examined water quality parameters as a function of land use within the watershed area. The WSI is a value reflecting the flow of point and nonpoint sources within the watershed both in terms of chemical concentrations and volume flow. The general relationship established between water quality and watershed pollution sources was examined through a plot of WQI and WSI values (Figure 1). High values of total phosphorus were associated with population centers and areas of intense industrial activities such as strip-mining and industry. Forested areas retain considerably more phosphorus than rangeland. PNS watersheds with waters highly polluted with municipal wastes also show levels of phosphorus.

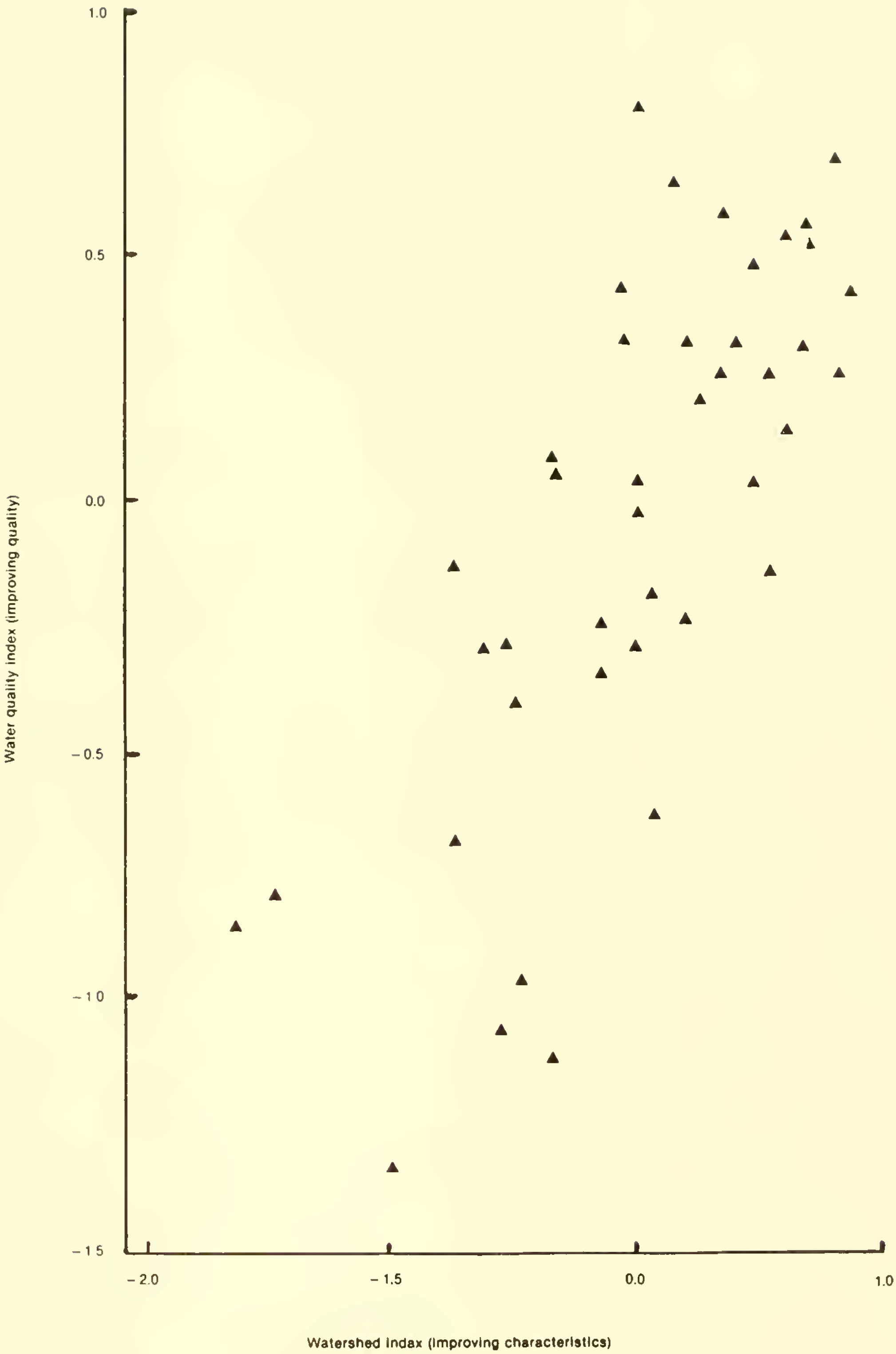

Figure 1. Water quality index versus watershed characteristics index for 42 permanent network station watersheds (correlation coefficient = 0.74) (Florida State Department of Environmental Regulation 1979b).

Concentrations of natural organic nitrogen (TKN and Org-n) were highest in wetlands with water storage, and in rangelands. Sewage flow also was highly correlated with nitrogen concentrations. High levels of organic nitrogen appear to be caused by agriculture and industry because of nitrogen fertilizer used on agricultural lands.

Increases in biological oxygen demand (BOD) were directly related to increases in sewage flow. Dissolved oxygen was negatively correlated with wetlands and rangeland. This agrees with the BOD analysis. Runoff from rangelands and washed out organics from wetlands could indirectly cause oxygen depletion in the receiving waters. Increased sewage often decreases dissolved oxygen concentrations because of an increase in BOD.

The best available forecast for sewage treatment plant flows for the seven counties is given in Table 2. This forecast and relevant population projections by the University of Florida suggest a moderate 2% to 2.5% annual population growth. Without greater pollution control, water quality may decline because of increased point source loadings from secondary treatment facilities and industrial expansion.

Increased urbanization, industrialization, and water related development suggest that in some areas water quality may decline within the next several decades. The specific amount of decline is difficult to predict within any degree of accuracy and, therefore, should only be identified in terms of direction and probable magnitude.

Phosphorus and nitrogen concentrations may increase as agricultural activity intensifies and expands. As urbanization expands in Northwest Florida, forest areas will be cleared and marsh wetlands drained. As a consequence, BOD, DO, inorganic nitrogen, and phosphorus also will increase. Adequate regulatory controls, including permits for point source and regulatory management of nonpoint sources, minimize violations of water quality standards in Northwest Florida.

COASTAL RESOURCE ISSUES

Class II and III Salt and Brackish Water

Saltwater areas identified under the Class III designation are for propagation of saltwater species of aquatic life and for recreation. A special classification also is designated for shellfish. The Class II designation is often far more restrictive because of the filter-feeder nature of the shellfish growing within the particular Class II designated areas. Shellfish often absorb and biomagnify certain pollutants in the feeding process. They are not able to relocate or avoid pollution as are more mobile species. The discussion of Class II and Class III standards will be incorporated under the general coastal resource designation. Where necessary, differentiation between Class II and Class III will be made. The aquatic resources under consideration here are Apalachicola Bay, Choctawhatchee Bay, East Bay, Escambia Bay, Perdido Bay, St. Andrews Bay, and St. Joseph Bay.

In general, estuaries are characterized by a high level of dissolved oxygen, medium chlorophyll-a and DO concentrations, and low to medium coliform

Table 2. Needs and costs of sewage treatment plants through year 2000 (Florida State Department of Environmental Regulation, Office of Economic Analysis 1981).

County	Average annual population growth rate[a] (percent)	Growth in design capital (Mgal/d)	Number of new facilities[b] expected	Single[b] plant capital costs ($millions)	Estimated total[c] capital costs ($millions)
Bay	2.50	3.99	28.00	6.21	17.14
Escambia	2.10	9.41	20.00	11.29	27.89
Franklin	2.50	0.55	6.00	1.57	2.66
Gulf	2.50	0.13	1.00	0.57	0.49
Okaloosa	2.10	5.55	11.00	7.82	16.13
Santa Rosa	2.10	1.49	8.00	3.13	5.83
Walton	2.50	0.61	5.00	1.68	2.76
Region	--	21.73	79.00	32.27	72.90
Florida	--	1366.82	4243.00	936.04	4007.72

[a] University of Florida Bureau of Economic and Business Research, Population Divisions forecast.
[b] Assumes historical mean for each county.
[c] Based on EPA construction costs curve [cost = \$1.77 $(\text{design})^{0.7}$] in 1981 dollars.

counts. Of all the Florida estuaries that were analyzed, the estuaries in Northwest Florida generally had the highest concentrations of dissolved oxygen. Nutrient concentrations were low at all stations in St. Joseph Bay. Organic nitrogen and ammonia averaged below 0.46 mg/l and 0.20 mg/l, respectively. Fecal coliform concentrations ranged from 2/100 ml in St. Josephs Bay to 205/ 100 ml in Perdido Bay, but most were below 100/100 ml. Counts averaged less than 600/100 ml in all estuaries, except St. Andrews Bay. Turbidity and suspended solid values were generally high, ranging from 2 to 22 JTU's and from 9 to 32 mg/l, respectively. Apalachicola Bay exhibited the highest values for both parameters and St. Josephs Bay exhibited the lowest. Diversity varies widely ranging from 1.7 in Perdido to 3.9 in St. Josephs Bay. Diversity depends on many factors including salinity. Among the bays, St. Josephs Bay and St. Andrews Bay had the lowest freshwater inputs and the highest diversity.

Overall,. water quality is excellent in most Northwest Florida estuaries. St. Josephs and St. Andrews Bay have the best water quality in the State. Perdido and Escambia Bay have the lowest water quality in Northwest Florida but compared to other Florida estuaries, however, its water quality is relatively good. In Northwest Florida a number of Class II fishing areas have been closed due to high fecal coliform concentrations. This has especially been a problem in the Apalachicola area where over a period of 18 months, numerous closings of the oyster fisheries were required. The Department of Natural Resources reported that these high total coliform counts were caused by municipal pollution and, to a lesser extent, natural conditions.

Economic Evaluation of Florida's Fresh and Saltwater Resources

As a peninsular state, Florida has an abundance of high quality fresh, brackish, and salt waters. Natural resources are abundant and the economy is linked to and dependent upon the natural resources with special importance attached to the quantity and quality of its freshwater supplies (Lynch 1977).

Florida's $17 billion tourist industry and the well-being of all its residents are linked to the quality of the water supplies. Based on lost fishing opportunities, Bell and Canterbury (1976) examined the cost of the effects of water pollution nationally and for Florida. The economic impact of pollution on marine resources in Florida due to sublethal effects of pollution, reduced bioproductivity and potential protein production; the closure of shellfish fishing areas has caused a loss of over 8% of the recreational potential of Florida. Researchers also examined potential benefits that would result if pollution were reduced as set forth in the Clean Water Act. They suggested that the potential increase in recreational days from 1974 to 1985 would nearly double (from 55 million to 105 million). This potential rise would increase the nonmarket value of sport fisheries in Florida by $133 million.

In a report released by the Department of Policy Sciences, Florida State University (Bell 1979), the saltwater fishery in Florida supports a $2 billion industry and and provides, directly and indirectly, over 118,000 jobs. The freshwater sport fishery was valued at over $1 billion in 1975 and supported directly and indirectly about 75,500 jobs. In 1980 dollars at a 6-7/8% discount rate, the sport fisheries of Florida was valued at $4.75 billion. This income is a major contribution to the recreation industry.

The shellfisheries are valuable in Northwest Florida. In 1972 in Franklin County, for example, about 5.9 million lb of fish were landed of which 85% (5.0 million lb) were shellfish. Shellfish abundance is dependent upon the quality and quantity of approved Class II shellfishing waters throughout Florida. Potential increases in the shellfish industry were examined by Bell and Canterbury (1976). This study, sponsored by the National Commission on Clean Water, forecasted that if the goals of the Clean Water Act were met in Florida, the annual shellfish production by species would increase as follows: shrimp by 19.7 million lb, spiny lobster by 10.5 million lb, oysters by 15.2 million lb, crabs by 8.9 million lb, clams by 1.1 million lb, and scallops by 0.765 lb. Menhaden production also would increase yearly by nearly 14 million lb if the goals of the Clean Water Act were attained.

The relative value of wetlands and Class II fisheries can be estimated through contemporary environmental economic methodology. Edmunsten (1977) surveyed the eight coastal counties from Escambia on the west to Wakulla on the east. Fifteen estuarine systems were identified including the major Class II productive resources of Northwest Florida. Bell (1977) used the Edmunston data and calculated an estuarine value of $60.91 per acre. A study completed by Gosselink et al. (1973) gives a value of $75.00 per acre for Florida's estuaries. Bell estimated that $13.83 per acre may be lost within the Class II estuarine areas of Santa Rosa County if the Navarre Pass is allowed to open.

Other estimates of damage by pollution verify the high value of fisheries in estuarine and coastal waters. Terbonne (1973) estimated that the annual economic loss to the fishery from water pollution alone in the Pensacola area in 1972 was over $3 million. This loss can be further magnified throughout the economy by multiplier effects.

Ecological Stress Induced from Natural and Manmade Factors

Since about 1960, extensive areas of Florida's interior wetlands have been dredged, diked, and drained, which has led to major alteration of Northwest Florida's coastal wetlands. Major coastal ecological alterations are habitat stress, dune destruction, reduced flow of detritic food sources for aquatic life, decreased dissolved oxygen, increased coliform counts, and reduced runoff through natural systems. Natural eroding processes, such as beach and river erosion, and man-induced destruction of natural vegetation and habitat, have reduced wildlife potentials in the area.

Northwest Florida is an area of great hydrologic activity because of its long and dynamic coastline, tidal influences, and extensive river networks with high volume flows. Beach erosion is common on barrier islands and shoreline spits that reach into the gulf. Franklin County, with seven beaches, has the most serious beach erosion.

Almost every county in Northwest Florida has undergone relatively severe habitat alteration. Most dominant is the destruction of natural vegetation by clear-cutting, drainage, diking, and channelization, or monoculture of pine and pasture lands. The value of tidal marshes has been estimated to be $6.91 per acre or a capitalized value of $69.10 per acre using a 10% discount rate (Lynne 1978).

Solid waste problem areas are identified in Tables EIR 1 and EIR 2 (Data Appendix). These sites have high nitrate concentrations, low DO, and excessive aquatic plant growth.

Future Trends

The increasing population in Northwest Florida will cause further habitat alteration. A case study in the multiple-use conflicts paper of this report examines potential developments planned for the St. George Barrier Island in Franklin County. Rapid growth and housing development along coastal wetlands will likely increase stress on natural systems there. Franklin County has recently closed extensive Class II fishing grounds due to high coliform counts. These trends can be averted with adequate planning for pollution abatement prior to large scale urban or industrial development. More intensive agricultural and silvicultural practices in Northwest Florida will likely lead to more monoculture and further draining of wetlands that help sustain the coastal fisheries. The loss of major wetlands to pasture, crops, and urbanization could endanger the thriving commercial and sport fisheries in the area.

Other Significant Biological Resources

The endangered and threatened species (mammals, birds, reptiles, amphibians, and plants) are listed in Tables EIR 46, 47, 48, 49, 50, 51, and 52 (Data Appendix).

Public Ownership of Land

Extensive tracts of land, owned by both Federal and State Governments, are used for various purposes. These include military reservations, such as the Eglin Air Force Base in Santa Rosa, Okaloosa, and Walton Counties and the vast holdings of the Apalachicola National Forest throughout the Franklin County area. Numerous other tracts are used for the U.S. Navy, and Federal and State public forests, such as the Osceola and Cary State Forests, and other areas judged to be sensitive habitat, warrant purchase by the State under its Environmentally Endangered Lands Program (Figure 2).

Environmentally Endangered Lands Program

In Northwest Florida the three environmentally endangered lands are Perdido Island (Key), Little St. George Island and the Lower Apalachicola River Basin. More similar purchases are being considered.

Aquatic Preserves

Northwest Florida has an abundance of highly productive and well-protected preserves including the Ft. Pickens State Park, the Yellow River Marsh, Rocky Bayou State Park, St. Andrews Park, St. Josephs Bay, Apalachicola Bay, and Alligator Harbor.

Aquatic preserves are administered by the Department of Natural Resources as set forth in the Florida Aquatic Preserve Act of 1975. It states in part:

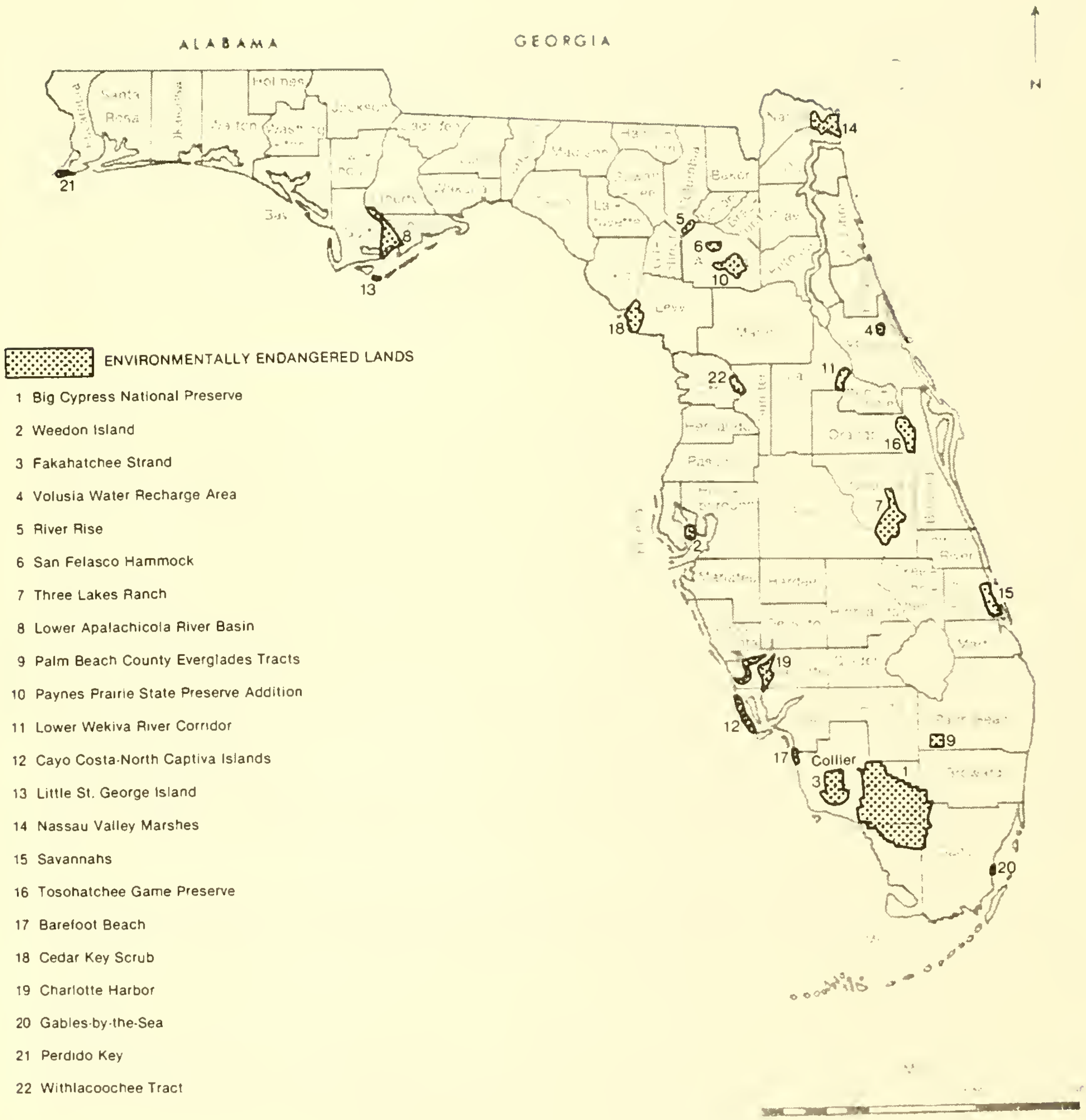

Figure 2. Environmentally Endangered Lands (Florida Power and Light Co. 1979)

> It is a legislative intent that the state-owned submerged lands in the areas which have exceptional biological, aesthetic and scientific value hereinafter described ... shall be set aside forever as aquatic preserves or santuaries for the benefit of future generations (Ch. 258, Florida Statutes).

Waste disposal, dredging, and filling are severely curtailed in aquatic preserves. Seven such aquatic preserves are located in Northwest Florida.

Outstanding Florida Resource Waters

The Department of Environmental Regulation (DER) under its water quality designation authority set aside certain bodies of water and segments of other bodies for special protection and entitled this specific designation as an "Outstanding Florida Resource Water." This designation is declared under the provisions of Ch. 17-3, Florida Administrative Code (FAC). Under this designation, certain bodies of water, because of their unique ecological characteristics and value, are to retain their essential pristine state in the future. No significant further degradation of those bodies of water are authorized. Within the region a large number of water bodies have received this special classification. A complete list is available in Ch. 17-3, FAC.

Class I Drinking Water

Federal and State Standards. The Federal Safe Drinking Water Act of 1974 instructs the U.S. Environmental Protection Agency (EPA) to establish regulations for safe water for human consumption (PL 93-523). The State of Florida has taken the Federal guidelines and incorporated them into the Class I water quality criteria. These standards set forth the minimum criteria required for safe levels for both surface (Class IA) and ground (Class IB) sources of potable water. Northwest Florida has an abundance of high quality potable water. A Class IB underground source of drinking water is an aquifer or part of an aquifer that supplies water suitable for drinking, and contains less than 10,000 mg/l of total dissolved solids. Approximately 92% of the State residents depend upon Florida's aquifers for a source of potable water. In Northwest Florida citizens are largely dependent on the Floridian aquifer (the State's largest) and shallow sand-and-gravel aquifers. Part C of the Federal Safe Drinking Water (PL 93-523) establishes guidelines for State programs to protect present and future sources. Florida's extensive aquifer network supplies drinking water with 250 mg/l or less total dissolved solids.

Several potential pollution sources could adversely affect Florida's potable groundwater. These sources of contamination include municipal and industrial discharges as well as surface water, impoundments, and solid waste disposal sites (Figure 3).

To protect Florida's valuable groundwater resources, a series of regulatory programs has been enacted. The most significant is an underground injection control program. This program is designed to ensure that injected fluids from Florida's 6,858 injection wells stay in the intended injection zone and do not migrate into drinking water supplies (Figure 4).

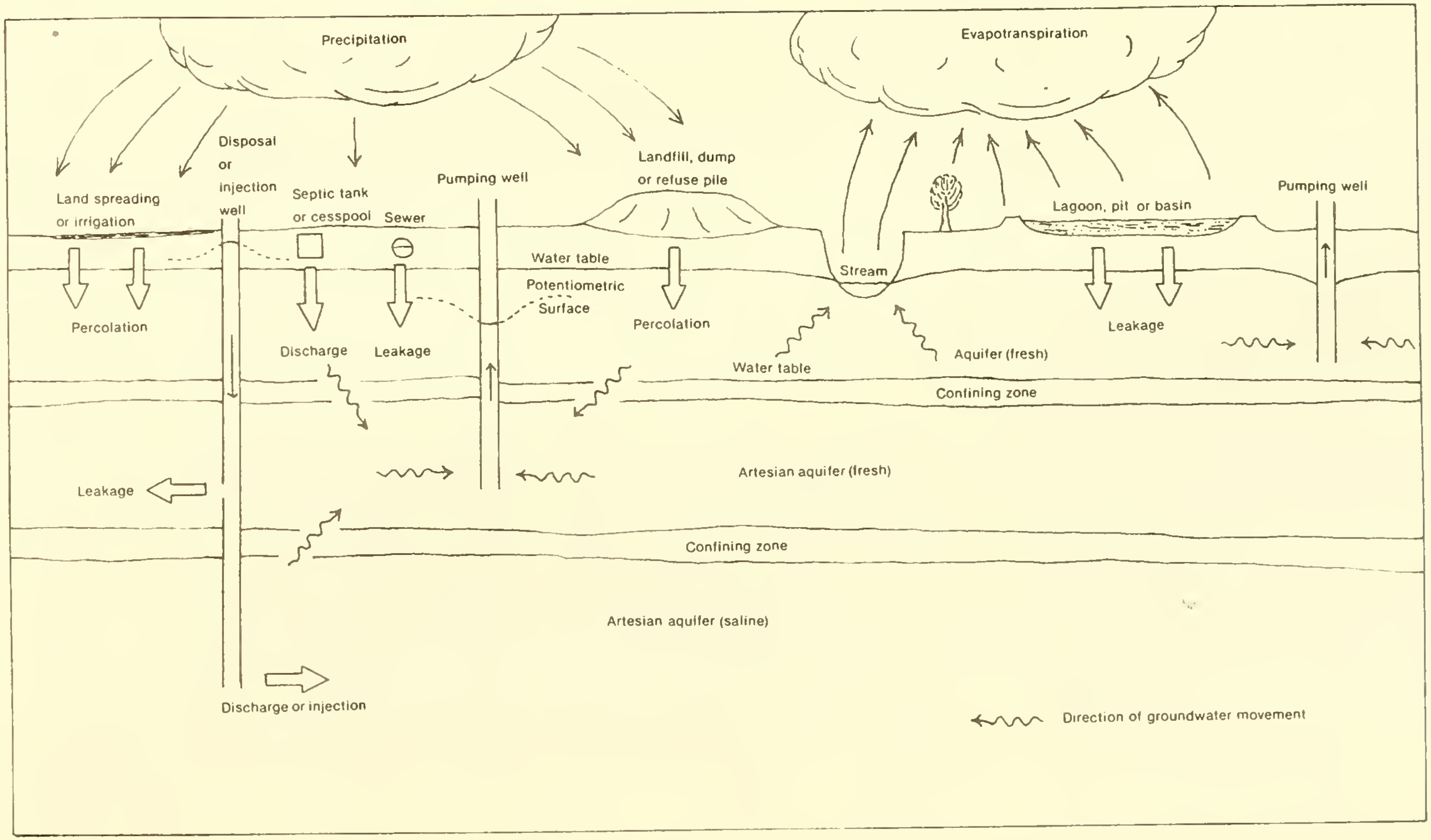

Figure 3. Contamination of the groundwater system by waste disposal practices (Environmental Protection Agency 1977).

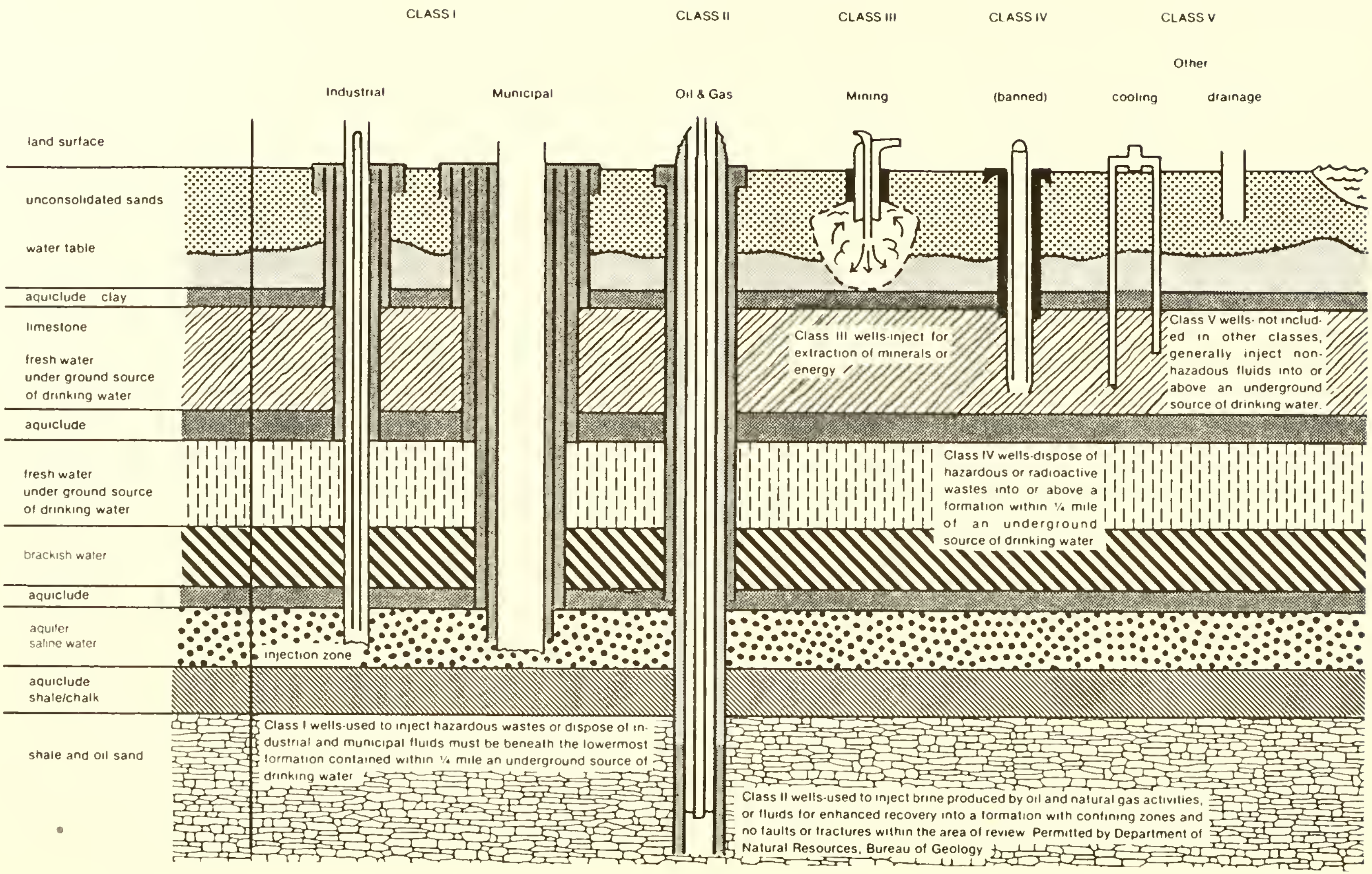

Figure 4. Underground injection control program classification of wells (Florida Department of Environmental Regulation 1981d).

Class II and III well permits are issued by the Department of Natural Resources, Bureau of Geology. The other classes of permits are issued through the DER, the most important of which are the industrial and municipal class wells (Florida State Department of Environmental Regulation 1981).

Of the five largest industries in Florida discharging their wastes through deep-well injection, two (Monsanto and American Cyanamide industries) are in Northwest Florida. Both use deep-well injection for disposal of acidic chemical wastes from the synthetic fiber plants. Monsanto discharges 3 Mgal/d, whereas American Cyanamide discharges 0.7 Mgal/d into deep-well confined areas. Monsanto, the largest industry in Northwest Florida (it employs 5,000 people), has been injecting through deep-wells since 1963, whereas American Cyanamide has been using injections since 1975 (Department of Environmental Regulation, Bureau of Groundwater Analysis, 1981: personal communication).

In Northwest Florida there are six Class I, 53 Class II, no Class III, and 66 Class V injection wells. Escambia has one air conditioning well and one cooling injection well, and Bay County has 5 air conditioning injection wells. Santa Rosa, by contrast, has 47 Class II wells.

The State is using every technically feasible precaution to protect the quality and quantity of groundwater. No reported groundwater contamination violations have yet been noted from deep-well injection facilities (Conversation with Dr. Rodney DeHan, Department of Environmental Regulation, Section Administrator, Groundwater Section, Tallahasee, FL, July 1981).

Water Quantity

Vast quantities of water from groundwater and surface water sources are used for industrial, municipal, and agricultural purposes every year. For self-supplied industries, Escambia County produces 47.3 Mgal/d, Okaloosa produces 5.4 Mgal/d, and Santa Rosa produces 19 Mgal/d. Escambia County also produces 116 Mgal/d of saline groundwater for industrial use. Groundwater there is largely used in processing pulp paper and chemical products. In Santa Rosa County, chemical products industry is the major water user. Although groundwater supplies in certain areas such as Fort Walton Beach are seriously depleted, Northwest Florida generally is water rich in quantity and quality.

Hazardous and Solid Waste

The disposal of hazardous and solid wastes is a problem in Northwest Florida. Highly porous sandy soils and subsurface contamination have caused serious problems for the disposal and treatment of hazardous wastes. Steps must be taken to neutralize wastes prior to their discharge (Roy 1979). Various hazardous wastes have had wide reaching effects.

The potential loss of commercial fishes from oil spills along the St. Marks River and port facility has been estimated to be about $328,000 annually (Bell et al. 1982). In another analysis of surface and groundwater contamination near hazardous waste sites, Lynch (1981) estimated that a hazardous waste facility discharging heavy metals and sulfuric acid from a battery reclamation facility caused over $6 million in damage to the environment. Losses included costs for restoration, and extensive damage to the freshwater fisheries in Dry

Creek and Chipola River, and other waters all the way into the Gulf County Dead Lakes area. Furthermore, the effects of this heavy metal contamination may have gone downstream as far as Apalachicola Bay. Although the cost of groundwater pollution is yet unknown, it is certain to be relatively high. Some wells in the drainage system contain heavy metal contamination above EPA standards. These hazardous waste violations could have been avoided if $300,000 were used for proper treatment and disposal of liquid wastes (Lynch 1981).

In another major hazardous waste accident in 1978 in Youngstown, Bay County, a train derailment ruptured a railroad tank car carrying several thousand gallons of liquid chloride. Eight deaths and more than 100 injuries were reported and about 3,700 people were evacuated within a 10-mile radius of the accident. In addition to the personal suffering from this tragedy, extensive costs were incurred by local, State, and Federal agencies involved in the rescue and treatment of injured persons.

A number of hazardous incidents were identified by the Department of Environmental Regulation. They include hazardous waste discharges from industrial sites where chemicals are discharged either by accident or as a last resort, causing fish-kills and destruction. In another accident involving train derailments, serious damage to aquatic life in the Yellow River was caused by chlorine wastes. Northwest Florida does not have a full federally authorized hazardous waste land fill disposal facility; the nearest one available is the Chemical Waste Disposal Facility in Livingston, AL, 200 mi away.

ENVIRONMENTAL ACTS AND REGULATIONS

Throughout this report specific references have been made to existing State, Federal and local regulatory standards in appropriate natural resource categories. A discussion of the Federal and State water quality standards classification scheme was outlined under the water resource issues, and a similar examination of State and Federal standards was undertaken in the air quality segment of this report. These discussions, however, fail to provide a sufficient broad-based review of the existing Federal, State and local regulatory framework within which reviewers and users of this report can be guided. The following analysis is a brief review of major environmental acts and regulations.

FEDERAL

Federal Aid and Wildlife Federation Act, 1937

The purpose of this act is to inaugurate a program of Federal aid to the states for the restoration and management of wildlife. Through this Act, about $350 million have been allotted to state fish and game department wildlife restoration projects.

Fish and Wildlife Act of 1956

The purpose of this bill is to provide a framework in which the problems of the commercial fishing industry can be resolved, and give recognition to the importance of outdoor recreation. This Act established the United States Fish and Wildlife Service in the Department of Interior.

Fish Restoration and Management Projects Act

This act is designed to provide Federal aid to the states for restoration in the management of their fisheries resources, financed through a special fund from a tax on fishing rods, reels, bait, flies, and other fishing related expenditures.

Estuary Protection Act P.L. 90-454

This act authorizes the Secretary of the Interior to conduct an inventory and study of the Nation's estuaries, working towards the goal of protecting, saving, and restoring them.

Marine Sanctuaries Act of 1972

This act authorizes the Secretary of Commerce, with the approval of the President, to designate as "Marine Sanctuaries" those areas of coastal waters, as far out as the outer edge of the continental shelf, or of coastal waters wherever the tide ebbs and flows, which he determined need Federal protection in order to maintain their ecological and recreational values. In 1979, this act was employed in southwest Florida for designation of the Apalachicola Marine Sanctuary.

Endangered Species Act of 1973

This act provides mechanisms through the Secretary of Commerce for protection of endangered species of fish and wildlife by way of direct Federal action and by encouraging states to establish conservation programs. Enforcement include civil and criminal penalties.

Federal Insecticide, Fungicide, and Rodenticide Act as amended by the Federal and Environmental Pesticide Control of 1972, P.L. 92-516

The purpose of the original legislation was to control the composition of the pesticides through adequate labeling and instructions and tests on side effects, and for registering aquatic poisons. The amendment initiated a system to prevent indiscriminant application of pesticides to protect fish and wildlife.

Federal Water Pollution Control Act

The passage of this act was the Federal Government's first major intent to take an active role in the fight against water pollution. The original 1948 Act emphasized state control, but was limited in scope to interstate waters and tributaries.

Federal Water Pollution Control Act Amendments of 1972 P.L. 92-500. The 1972 Amendments completely revised and restructured the 1948 Act. The major goals of the act were to:

- o Eliminate the discharge of pollutants into navigable waters by 1985, and maintain water quality suitable for fish and wildlife, and other forms of recreation by 1983.

- o Prohibit the discharge of toxic pollutants.

- o Provide financial assistance to construct publicly-owned waste treatment works.

- o Develop and implement area-wide waste treatment.

- o Develop the technology necessary to eliminate the discharge of pollutants into navigable waters.

To attain these goals, the emphasis of legislation has been changed from water quality standards to effluent limitations. The new approach uses effluent limitations as a basis to eliminate pollution by 1985. Water quality standards also are established in the new act. States such as Florida may set up their own water quality standards based on the Federal Class I through Class V classification system.

The 1972 amendments require that all publicly owned sewage treatment plants provide a minimum of secondary treatment by 1 July 1977 and advanced waste treatment by 1 July 1978. The amendments also require that industrial discharge should meet the best practical technology requirements by 1 July 1977 and the best available technology by 1 July 1983. EPA has extended the deadlines to 1 July 1983 for compliance with requirements for publicly owned sewage treatment works as described below:

Type pollutant	Level of technology	Legislative deadline
Conventional	Best conventional pollution control technology	1 July 1984
Toxic	Best available technology economically achievable	1 July 1984 for existing toxic pollutants; 1 to 3 years after determination of new toxic pollutants
Nonconventional	Best available technology economically achievable.	3 years after effluent limits are established but no later than 1 July 1984 and never later than 1 July 1987.

Ocean Dumping Act

This act forms congressional policy to regulate the dumping of all types of materials into those waters lying seaward of the base line from which the territorial sea is measured. The act is particularly concerned with the

dumping of materials that would adersely affect human welfare and the marine environment.

Clean Air Act of 1963

The Clean Air Act revises existing air pollution laws in an attempt to strengthen basic authority as well as the role of the Department of Health and Human Services regarding air pollution.

Clean Air Act Amendments of 1970

This act is a reflection of the Federal Government's recognition of air quality as a national problem and its implicit acceptance of primary responsibility for air pollution control. These amendments provide for advanced air pollution abatement timetables and significantly greater Federal involvement including increased civil penalties. It is also the first attempt to control auto emissions. The act further establishes procedures for EPA to promulgate national ambient air standards based solely on factors relating to public health and welfare without regard to technological and economic feasibilities.

In April 1971, EPA issued the first national contaminant standards for sulfur oxide, carbon monoxide, particulates, photochemical oxidents, hydrocarbons, and nitrogen oxides. National ambient air quality standards for lead have since been prepared. Primary standards are designed to protect public health and secondary standards are designed to enhance the environment.

EPA also has set standards of performance for certain stationary sources of pollution. Some of these emission standards apply to new and existing point sources, whereas others apply specifically to new sources. Some pollutants are so hazardous that the act requires direct Federal standards and enforcement to protect the public health. National emission standards have been set for asbestos, berylium, mercury, and vinyl chloride. Benzene has also been designated a hazardous air pollutant in June 1977.

Section 220 of the act calls for development by each state of a plan for the implementation, maintenance and enforcement of primary and secondary standards of air pollution. These plans, called State Implementation Plans, (SIP) must assure air quality consistent with the national standards.

Currently, amendments are being made to the Clean Air Act in Congress. The provisions for changes to the Clean Air Act as recommended by the National Commission on Air Quality were made to strengthen the existing Federal and state programs. Proposals to do away with the Prevention of Significant Degradation requirements and other administrative Federal mandates were submitted to Congress in the Spring of 1981.

Resource Recovery Act of 1970

This act was designed to provide Federal assistance to state and local governments to assure proper disposal of solid wastes.

The Resource Conservation and Recovery Act of 1976

This act sets out to broaden the national solid waste management program, and conserve natural resources through waste reduction, and minerals and energy recovery. EPA is authorized to:

- o Regulate the disposal of all hazardous wastes.
- o Establish state regulatory programs to close all open dumps and control all land disposal of solid wastes, including sludge.
- o Encourage the development of basic national resource conservation and recovery policies.

Toxic Substances Control Act (P.L. 94-469)

The Toxic Substances Control Act authorizes EPA to obtain data from industry on selected chemical substances and mixtures and to regulate the substances when needed. Chemicals used exclusively in pesticides, food, food additives, drugs, nuclear materials, tobacco, firearms, and ammunition are exempt from this act.

National Environmental Policy Act of 1969

This act requires the preparation of a detailed environmental impact statement whenever there is a proposed major Federal action that would significantly affect the quality of the human environment. Environmental impact statements must be prepared prior to any major Federal activity in the coastal zone, including offshore energy development.

National Flood Insurance Act of 1968

This law provides limited indemnification to the victims of flood disasters through flood insurance to residents of flood-prone areas, provided that local jurisdictions require land-use control measures to guide safe use of flood zones.

Coastal Zone Management Act of 1972, and Amendments of 1975

The purpose of this act is to encourage the development of comprehensive state management programs and to formulate a national coastal zone policy for lands in the coastal zone area. It is implemented by the Office of Coastal Zone Management, National Oceanographic Atmospheric Administration, Department of Commerce, and provides assistance to coastal state governments for the development and implementation of coastal zone management plans. These plans are designed to assure the orderly and environmentally sound development of the coastal zone. Recent amendments to the act provide additional financial assistance to coastal states for new facilities and additional planning needed to offset coastal energy development. In Florida the Coastal Zone Management plan is in the final stages of development and approval.

Submerged Lands Act

This act is designed to promote the exploration and development of petroleum deposits by settling disputes between state and Federal governments over rights to ownership of submerged lands. Its importance is in terms of managing, leasing, and developing offshore energy. It serves as the basis for ownership disputes over state and Federal jurisdiction of the submerged lands of the continental shelf seaward from state boundaries. In the Gulf of Mexico, Florida and Texas state boundaries extend seaward approximately 9 mi; other state boundaries extend seaward only 3 mi. The Secretary of the Interior designated the Bureau of Land Management (BLM) as the administrative agency for leasing submerged Federal lands; the U.S. Fish and Wildlife Service (FWS) helps design environmental studies and acts in an advisory capacity through much of the leasing process.

STATE OF FLORIDA

The State of Florida, since the late 1960's, has been very active in promulgating and enforcing environmental legislation. This section will identify the major laws and briefly discuss the most significant environmental programs. A matrix of major environmental legislation and affected state agencies and activities related to permitting in the coastal zone is given in Figure 31, Part 2, Data Appendix. The most significant environmental laws enacted in Florida are reidentified and listed in this matrix, as are the major Federal and state agencies, in addition to a listing of the state legislative mandates used to manage activities and uses of water and land within the coastal zone. The most useful laws for environmentalists are given in the following sections.

Pollution-spill Protection and Control, Florida Statutes, Chapter 376-Section 376.021

This statute addresses the transfer of pollutants between vessels and/or between terminal facilities. The potential discharge into the environment of products being transferred poses a threat to the environment. These pollutants include many grades of oil, pesticides, ammonia, chlorine, and their derivatives. The statute requires a registration certificate for the operation of terminal facilities and gives authority to inspect the facilities to determine if they comply with regulations.

This statute establishes the mechanism to help in clean-up and rehabilitation of the environment after a pollutant has been discharged. The Florida Coastal Protection Trust Fund states that any owner or operator causing the pollution shall be liable for all clean-ups and abatement costs. An excise tax of 2 cents per barrel of the pollutants (mostly oil) has been assessed by the State of Florida to clean-up chemical spills.

Energy Resources Part II, Regulation of Oil and Gas, Florida Statute 377 Section 377.242. This legislation states that no drilling permit shall be granted within one mile inland from the coastline unless sufficient environmental protection provisions have been taken to protect the state's estuaries, beaches, and shorelines. Issuance or renewal of the permit requires a valid deed, or lease, granting the rights to oil and gas exploration, and satisfactory evidence that the applicants will clean-up any for which they are respon-

sible. The Department of Natural Resources has the responsibility for the rules' administration.

Environmental Land and Water Management Act, Florida Statute 380

The purpose of this act is to develop management strategies and policies to protect natural resources, the environment, and the water quality of the State. This is accomplished through designation of "Areas of Critical State Concern" by the Administration Commission if the areas are deemed to have significant environmental, historical, or archaeological resources of statewide importance. The three currently designated critical areas are the Green Swamp, the Big Cypress Swamp and the Florida Keys.

The second component of this statute defines the Development of Regional Impacts (DRI). A DRI is any development that because of its character, magnitude or location, would have a substantial effect on the health, safety, or welfare of citizens of more than one county. A number of DRI's have dealt with large-scale residential, commercial, and transportation related activities, and have required high levels of review and scrutiny from Regional Planning Councils and the Department of Community Affairs. DRI permits, which may include energy facilities, industrial plants, mining operations, petroleum storage facilities, or port facilities, involves integrated State and local review of environmental and socioeconomic factors.

Beaches and Shores Prevention Act, Florida Statue 151 (1975)

This act provides for a 50-ft construction setback line from the mean highwater line to be established on a county-by-county basis throughout the coastal areas of Florida and prohibits construction seaward of that line without a waiver or a variance. The statute requires permits for any coastal construction or reconstruction. The Division of Marine Resources enforces and coordinates provisions of this law.

Florida Statute 403.11 and 403.4152 (1975)

Legislation in Part I of Chapter 402 declares that the pollution of air and water in the State constitutes a menace to public health and welfare and is harmful to fish and othe aquatic life and detrimental to domestic, agricultural, industrial, recreational, and other beneficial uses of air and water. The public policy of the State is to conserve the air and waters of the State and to protect the propagation of wildlife, fish, and other aquatic life.

Statute 403.062 states that the department has general control and supervision of underground waters, lakes, rivers, streams, canals, ditches, and coastal waters inasmuch as their pollution may affect public health or interests. Section 403.088 states that permits are required for stationary installations that are expected to be sources of air or water pollution. The discharge of any waste into the waters of the State is prohibited without authorization, and water quality standards will be enforced. Section 403.061 grants to the DNR the authority to enforce these provisions, and Section 403.085 states that permits are required for ocean outfalls. Secondary treatment or other treatment may be required as necessary before the permit will be granted.

State Parks and Preserves, Florida Statute 258

The three main developments in this statute are as follows:

- o Miscellaneous parks and preserves created (258.08-.165). This section establishes six separate parks and preserves around the State and provides for their maintenance and administration. The aquatic preserves of Boca Chega and Biscayne Bay are created. Further development of bottomlands through dredge and fill is prohibited.

- o State Wilderness System Act of 1970 (258.17-.33). The general intent of this act is to establish a permanent system of wildlife preserves.

- o Florida's Aquatic Preserve Act of 1975 (258.53-.46). This act is intended to preserve forever state-owned submerged lands in areas that have exceptional biological, aesthetic or scientific value. In these areas, no further alienation by the State by dredging and filling, bulkheading, mining or development will be permitted except for specific exceptions. Section 258.3(c) prohibits drilling for gas or oil within a preserve but permits drilling from outside the preserved area. The DNR administers the Aquatic Preserves, State Wilderness Areas, and State Parks and the Governor and Cabinet, sitting as the board of Trustees of the Internal Improvement Trust Fund, have final approval regarding these facilities and areas.

Game and Freshwater Fish, Florida Statutes 372

This law prohibits contamination of fresh waters of such magnitude that it will damage freshwater aquatic life. This law is enforced by the Game and Freshwater Fish Commission.

Water Resources Act 1972: Part I, the State Water Resource Plan, Florida Statutes 373.013

The Florida Resources Act of 1972 covers all State waters unless exempt, and provides for the comprehensive management of water and related land use including development of dams, impoundments, reservoirs, and other works to provide water storage and to prevent damage from flooding, soil erosion, and excessive run off. Section 373.026 designates the responsibility to the DER for the broad powers and authorities under the Act, and supervision of the Water Management District.

Water Resource Management Act 1972: Part II-Permitting of Consumptive Use of Water, Florida Statute 373.203-.249

Section 373.219 requires a permit for the consumptive use of water and imposes reasonable conditions to assure that the permitted use is consistent with the overall objectives of the water district of the DER and not harmful to the water resource of the area. The use to which water is put must be a reasonably beneficial one; reasonable from the stand-point of other landowners and the public. The water management districts are authorized by the DER to be responsible for issuing consumptive use permits.

Local and Intergovernmental Programs, Florida Statute 163-.3191

This legislation enables counties and incorporated municipalities to plan for future development and to prepare, adopt, and amend comprehensive plans to guide future development. These comprehensive plans should include zoning and subdivision regulations, policies for land and water use, and building and electrical, gas, and sanitary codes. A coastal protection element shall be included for those units of local government lying in part or in whole in the coastal zone.

Local governments use their authority in relation to the environmental problems of OCS development in several ways. Land is administered to ensure environmental protection, and local governments have the authority to administer land- and water-use regulations. Local governments have the power of eminent domain, which can be used as an enforcement mechanism to ensure compliance with sewage and landscaping requirements, and environmental requirements, and to acquire land for necessary facilities. A local infrastructure already exists in some areas to regulate air and water pollution.

Each coastal community within the region has a coastal component of its comprehensive land-use plan either developed or in the development phases, such as the land-use provisions of the Sanibel Island Comprehensive Plan, Chapter 5 entitled, "Conservation/Coastal Zone Protection." To protect these basic resources, the objectives, policies, and implementation of the recommendations of Franklin County's Comprehensive Plan are predicated upon the following goal:

To guide development in such a manner that the basic functions and productivity of the County's natural land and water systems will be conserved over time, and to reduce or avoid health, safety, and economic problems for the present and future residents of Franklin County.

This element provides a set of objectives and policies designed for the comprehensive plan to accomplish its goal.

Local government's jurisdictional authority can either hinder or aid OCS and other energy-related facilities within its jurisdiction. Local governments can take land through eminent domain for development of public industrial parks, port facilities, utilities, or road easements. The same local governments can promulgate regulations on air, water, solids, and hazardous wastes that are more stringent than Federal or State regulations. They can request aid in funding certain activities that support OCS oil and gas related activities and may even be able to co-author municipal bonds for development of infrastructures and facilities essential for on and offsite support for OCS oil and gas production needs.

Chapter 253, F.S. enacted through Section 17-4.29, FAC

The jurisdictional authority of Chapter 253 is restricted to navigational waters (natural or artificial), mean high water line for waters subject to tidal action, and ordinary high water line on nontidal lakes. Focus is on fish and wildlife habitats, navigation impacts (potential obstructions to navigable waters), riparian rights, and water flow. If the proposed activity is

within an aquatic preserve, the additional requirements of Chapter 258, the Aquatic Preserve Act, are considered in permitting decisions. It is the Department's policy that any dredge and fill project over 10,000 yd is processed by the central office of the DER in Tallahassee, Florida.

Water Quality Based Discharge Permits

Chapter 403.087, and .088, F.S. implemented through Chapter 17-4.03, FAC. The provisions of these statutes direct the department to issue technology-based standards (such as 90% treatment required for sewage treatment facilities within the State), and effluent-based water quality wasteload allocations that limit the discharge for a particular facility up to the point of ambient water quality standards.

Air Quality Permitting Activities, Legislative Authority Chapter 403.087

Implemented through the provisions of Chapter 17-2, FAC. Emission levels are set through technology-based standards and ambient-based standards depending upon the nature of the source seeking the permit. The authority for all air quality permitting activities is enacted through Chapter 17-2, FAC. These restrictions include those for nonattainment areas, technology standards such as new source performance standards and best available control technology, and other State Implementation Plan authorities such as Best Available Control Technology determination and prevention of significant degradation.

DATA GAPS

One of the major problems in any environmental assessment is the lack of adequate and standarized information. Monitoring air, surface, and ground water conditions is designed to identify existing or potential problems. Monitoring of point sources pollution gives only a single view that is distorted if generalized to a broader area or time frame. Conversely, poorly placed monitors easily miss major environmental degradation and rate the quality too high. The complexity of interacting forces and a lack of useful measurement techniques may lead to bias in the final data.

Because of the lack of funding, monitoring equipment is frequently not placed in non-problem areas. In many areas of the State meaningful baseline air quality data are lacking. For example, air and water monitoring stations are located outside of major urban or industrial sites. Florida's ground water aquifer system has not been adequately monitored and the extent of potential risk from hazardous waste sites is not well understood.

Summary of Federal and State Dredge and Fill and Discharge Permit Requirements

The DER and the Army Corps of Engineers (COE) have a joint permitting agreement that authorizes an applicant to submit one basic application to both agencies for dredge and fill proposals. This joint application will be separately reviewed by the DER and COE to determine which agency has jurisdiction. The COE typically has broader authority in the headwaters of navigable streams. The general authority for COE is issuance of dredge and fill permits

for discharge of clean fill into navigable waters and supporting the Clean Water Act (Section 404), the Rivers and Harbors Act of 1899, and the Marine Protection Research and Sanctuary Act of 1972. The EPA additionally has the authority for issuing effluent permits under the provisions of the Clean Water Act and the Clean Air Act.

Florida Permitting Provisions establish the authority to administer and enact rules as set forth in State statute. (Legislative authorization for the DER's permitting activities are in Chapter 253, F.S. and Chapter 403 F.S.) The DER may issue and deny permits and define and refine those areas of established legislative authority consistent with the Florida Legislature. The rules established by DER set forth the implementation of the intent delegated through the statutes.

Within DER the two basic dredge and fill permit authorities are covered by Chapter 403, F.S., implemented through Chapter 17-4.28. This authority extends to certain listed waters of the State and to the landward extent to natural and artificial water bodies connected to the designated, listed water body. The definition of landward extent is established by the vegetative index in Section 17-4.02(17). The permitting jurisdiction under Section 403 focuses on short and long pollution problems judged in light of water quality parameters.

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ENERGETICS MODELS OF SOCIOECONOMIC SYSTEMS

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INTRODUCTION

This synthesis paper discusses the use of energetics models as a tool for studying socioeconomic and environmental systems. It provides a method for integrating the processes and components of natural and socioeconomic production. This paper also introduces the theoretical principles of energetics modeling and its limitations, followed by a discussion of the general methodology used in the design and execution of an energetics model. The results of an energetics model of Tampa and Hillsborough County in southwestern Florida are discussed, along with several other models, to show the types of research questions that can be answered using this method.

Different approaches have been proposed and tested for modeling natural and human systems. This paper focuses on the use of energy as a common denominator for all flows and storages within the systems under study. Energy circuit models are evaluated by measuring the quantity of energy flowing in a particular pathway or stored in the system. Because all activities, interactions, and even storages require energy, and in fact are energy, it is possible and practical to quantify a particular pathway by its energy value.

MODELING LANGUAGE AND SYMBOLS

The symbols used in the systems diagrams were established by Howard T. Odum (1971) and are part of the energy circuit language. The language combines several approaches that show energetics and provide insight into the mathematical description of a system, and illustrates a holistic approach. Energy circuit language contains a hierarchy of symbols that allow the diagramming of several levels of complexity in one model.

Several of the more commonly used energetics language symbols are illustrated in Figure 1. The water-tank-shaped symbol (A) represents an energy storage. The lines intersecting the storage symbolize energy flow pathways with flow in the direction of the arrows. The circle (B) is the symbol for an energy source which supplies power to the model from outside the systems boundary. The heat sink (C) is used to illustrate how waste heat or degraded energy is removed from the system.

The next three symbols (D, E, F) are group or subsystem symbols. These symbols are used primarily to aid in model organization. The hexagonal symbol (D) represents a self-maintaining consumer subsystem. A cow or city is an example of a consumer system. Consumers require concentrated energy from producers to operate, and feedback some energy to control the producer system. The bullet-shaped symbol (E) represents a producer subsystem. Producers are capable of upgrading dilute forms of natural energy such as sun, wind, and rain into more concentrated forms of energy such as plant biomass. The use of carbon from the atmosphere and nutrients from the soil by plants in the photosynthetic process is an example of a producer system. Producer and consumer systems are coupled to process energy and cycle matter within energetics models of systems of man and nature. The third group symbol (F) represents a logic action. The logic symbol is used to diagram a process in which the outcome has an off-on effect such as an electron.

The transformation process is represented by G. Relative dilute energy interacts with concentrated energy in the process symbol to produce some intermediate product. This symbol is commonly called a production function. An example would be the interaction of a plant with natural energy to produce plant sugar or the interaction of materials, fuels, capital, and labor in a city to produce a product. The energy and money transaction is represented by H. The solid line represents the energy flow and the dashed line represents the flow of money. The small circle is used to label the price (ratio of money to energy). This symbol is often used at the system boundary to control imports based on money stored in the system and collect money from exported products. The last symbol (I) is a flow sensor which is used to monitor flows of energy.

PRINCIPLES OF ENERGETICS MODELING

All energetics models, when designed properly, are consistent with the first and second laws of thermodynamics. The first law of thermodynamics states that energy is neither created nor destroyed; all systems of man and nature conserve energy. This principle of conservation of energy is incorporated into energetics models by requiring that the sum of all flows into a system, minus the energy flowing out, equal the net changes in energy storages within the system or any part of the system. In developing an energetics model that is consistent with the first law requirements, it is important that all energy flows be measured in their heat equivalent value.

The second law of thermodynamics pertains to the degradation of energy. This principle states that in all useful processes some energy must be degraded and thus lose its ability to do further work. Energetics models incorporate the second law by requiring heat sinks, or energy degradation flows, on all energy interaction and energy storages.

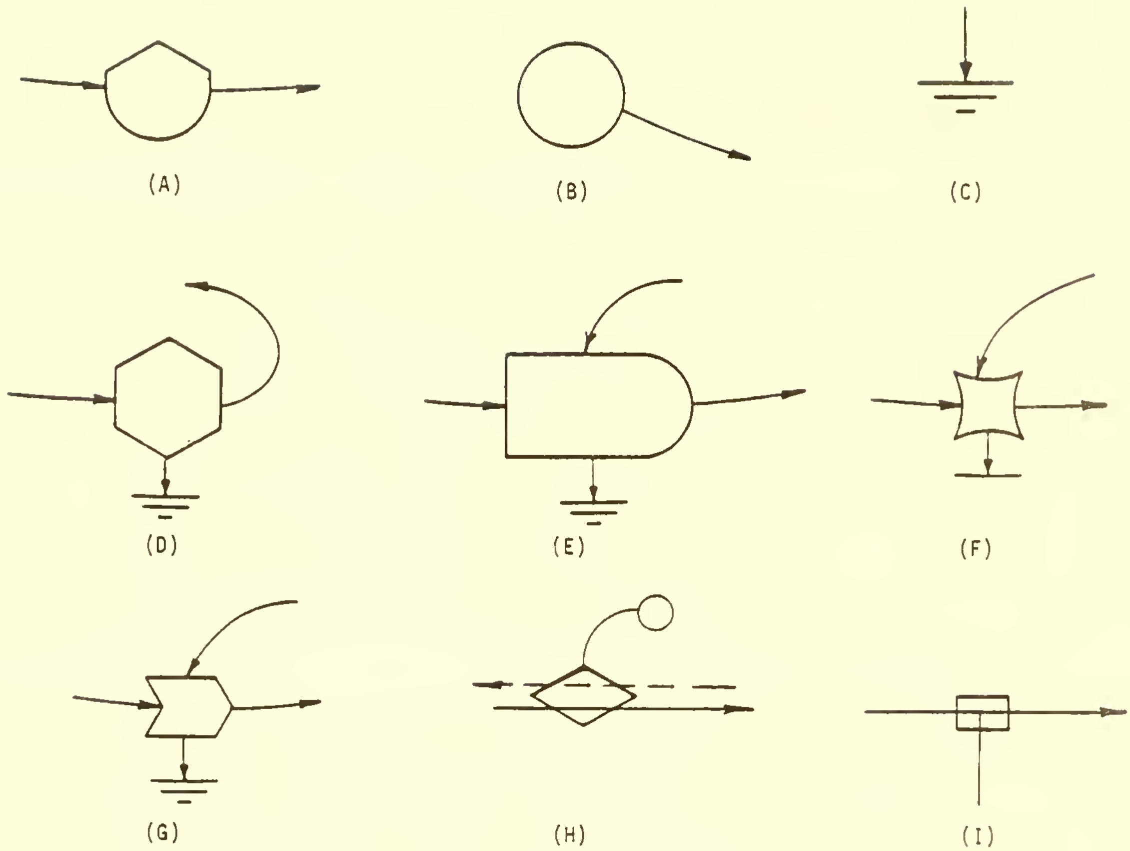


Figure 1. Energy circuit diagramming symbols: (A) energy storage; (B) energy source; (C) heat sink; (D) self-maintaining consumer unit; (E) self-maintaining production unit; (F) logic unit; (G) transformation or production function; (H) money energy transaction and (I) energy flow sensor.

The maximum power principle states that systems which take advantage of the maximum number of energy sources and use them most efficiently have the best chance of survival and are more competitive than systems which cannot sufficiently use the energy sources available (Lotka 1922). Charles Darwin's theory of survival of the fittest is an example of the maximum power principle when the system or subsystem under study is a living organism. An industrial example would be competition between two factories producing the same product; one only used wood as an energy source whereas the other used wood and coal.

ENERGY QUALITY

In assessing the capacity of energy to do work, more must be known than the total amount of available heat equivalent energy. This requirement can be illustrated by comparing wood and coal as fuels. Coal is a higher quality (more concentrated) fuel than wood. For example, it is more desirable to fuel a foundry with coal than wood because the more concentrated coal burns at a higher temperature. The difference in the energy quality of wood and coal is

a result of their composition. Coal is basically wood and other organic matter which, over periods of geologic time, has been compressed, heated, and eventually carbonized and has a higher energy quality factor (Table 1). The use of energy circuit modeling to diagram the flows of wood and coal into a foundry process is illustrated in Figure 2. Note the geologic upgrading of wood to coal in the model. The plants are diagrammed as a producer and the foundry as a consumer unit.

Table 1. Energy quality factors for various fuels (Odum and Odum 1976; Alexander et al. 1980b.)

Power Source	Energy Quality Factor (solar cal/cal)
Sun	1
Wood	1,000
Coal	2,000
Oil	3,400
Gas	3,400
Electric Power	8,000

The wood, coal, and oil and gas factors represent estimates of the different quantities of solar energy required to produce these fuels and also give an indication of how much of each will be required in a specific industrial process. The higher the quality factor of a given energy source, the better able it is to do useful work. Consequently, the energy quality factor, compared to solar energy, is the best indicator of the inherent worth of a given energy type. Quality factors provide a way of estimating the value of the natural energies and of comparing them to other types of energy such as those associated with animals, human culture, materials, and information (Odum and Odum 1976). Information in this context refers to the flow of concentrated energy between a sender and receiver as in a radio broadcast or human speech. The flow of information is an example of a very highly concentrated energy flow, i.e., it takes large quantities of solar energy to power systems which in turn produce information flows in a control action.

ENERGY AND MONEY

The interaction of energy and money of a farm is illustrated in Figure 3. In this simplified energy circuit model of a farm, renewable natural energy

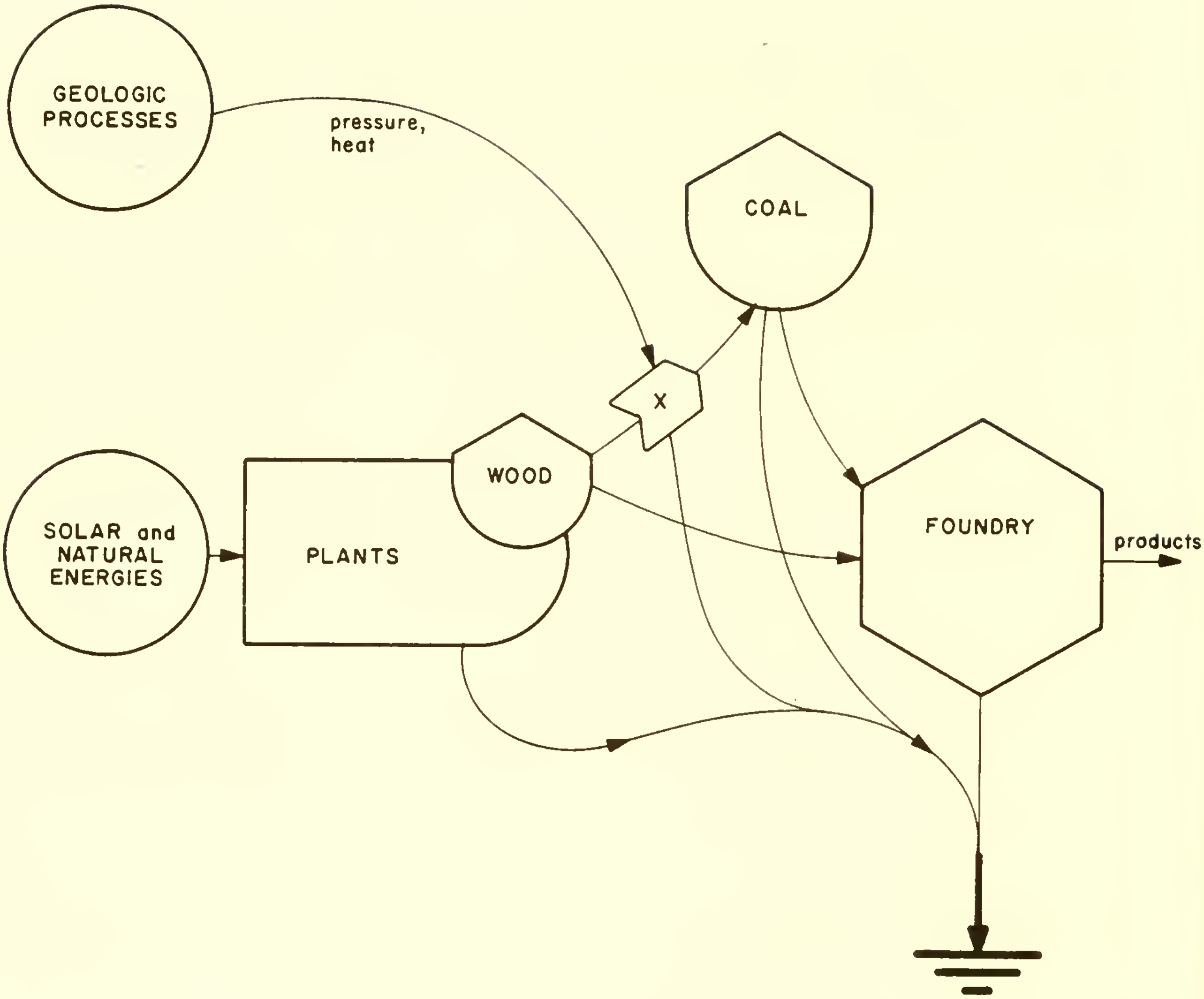


Figure 2. Energy flow model of wood and coal as fuel sources for a foundry.

such as sun, rain, and wind are used to power the crop growing process. The farm production consumer system contains equipment which is used to cultivate the soil and harvest the crop. The harvested crop exported from the farm system produces a flow of money into the farm in a direction opposite to the flow of exported energy. The money derived from the sale of produce is stored in the money storage tank. The stored money consequently is used to purchase fuels, goods, and services necessary to operate the farm.

For any nation, the ratio of dollar flow to energy flow, for a particular year, may be calculated by dividing the sum of all natural and fossil fuel energies entering the nation by the nation's gross national product. For example, in 1975 24.56 x 10^{15} calories of energy were consumed in the United States, whereas the gross national product was 1,526.8 x 10^{12} dollars. This calculation produces an energy to dollar ratio of 16,100 calories per dollar (Figure 4) and shows the ratio of embodied energy flow to gross national

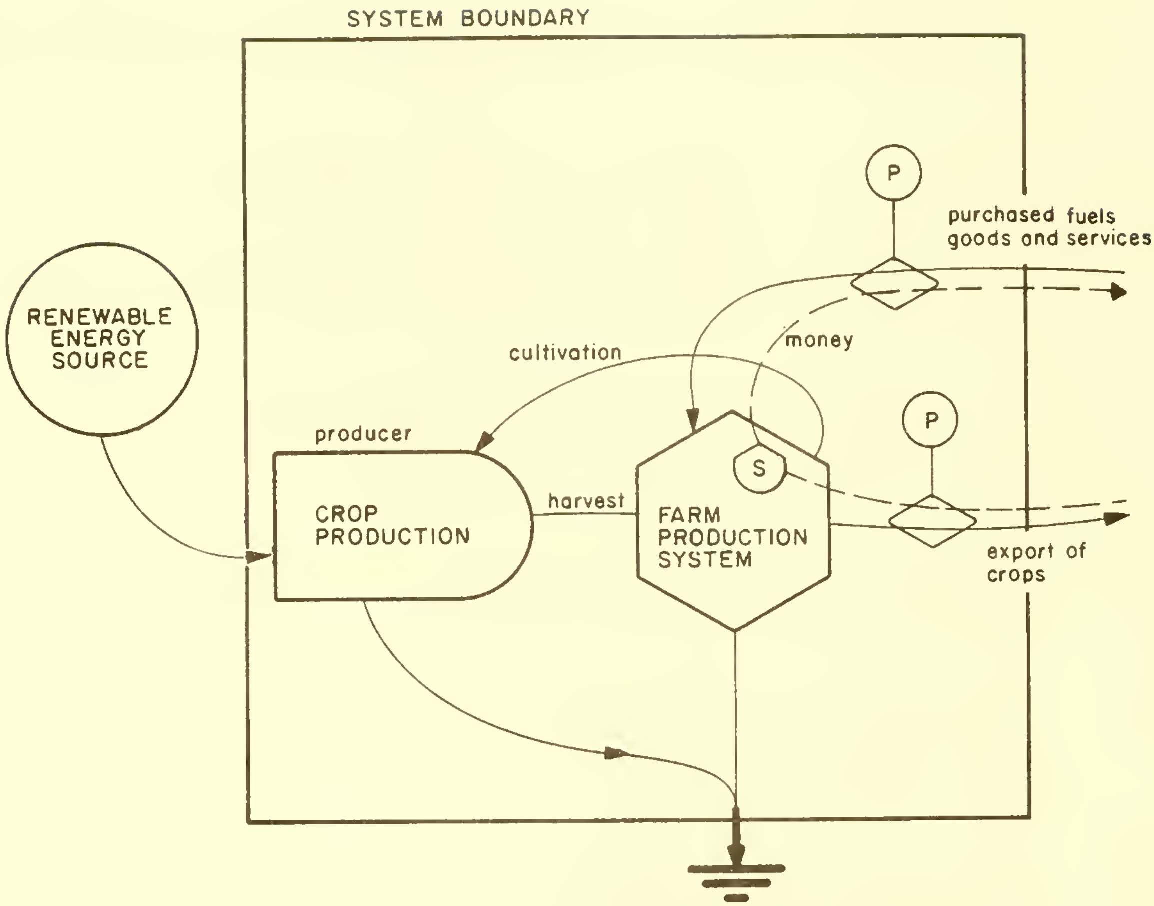


Figure 3. Energetics model of a farm illustrating the interaction of energy and money.

product for 1947-78 according to Odum et al. (1980). Energy to dollar ratios are useful when evaluating urban energy flows because the dollar value of a specific flow such as human labor often is the only data available. The dollar to energy ratio gives an estimate of the quantity of fossil fuel and natural energy required for the United States society to provide a specific function. Note the drop in energy per dollar of the United States gross national product.

One final point to be made concerning the relationship between money and energy is that the quantity of money flowing per unit of energy is constantly changing, as plotted in Figure 4. Non-renewable energy, such as oil, is recovered and processed for further use by human consumers. The consumers pay the energy processors for providing the service. As the more easily recovered fuels are expended, more energy must be used to recover the less accessible fuels. The result is that the same expenditure of energy, measured in terms of money, produces less usable energy, which causes inflation. Government policies which expand the national money supply also contribute to the declining energy to dollar ratio. When using money flows to estimate energy flows, the money-to-energy ratio will be dependent on the year that the data were

considerable recreational benefits to local residents. The problem is that many of the beaches have been badly eroded by either natural or manmade causes. The situation could be worse if there is no restoration or stabilization.

Erosion is one of the dynamic natural processes associated with beaches, but the imposition of manmade structures can cause critical economic losses. Urban development often aggravates beach erosion. In recognition of the beach erosion problem, the Coastal Construction Setback Line Law of 1970 (ch. 161 F.S.) was enacted. The legislature made the following pronouncements in conjunction with that law (Florida Department of Administration 1978).

> The attraction of Florida'a beautiful beaches and shores accounts for a substantial portion of the State's annual tourist trade.
>
> Beach and shore erosion is a serious menace to the economy and general welfare of the people of this State.
>
> Unguided development of these beaches and shores coupled with uncontrolled erosive forces is destroying or substantially damaging many miles of our valuable beaches each year.
>
> If construction or excavation is allowed to encroach upon the line of mean high water too closely, erosive processes are initiated or accelerated both at the site involved and on neighboring beach and shore properties as well.
>
> The greater public interests compel that certain enforceable restrictions be placed upon the location of coastal contruction and excavation even though such construction or excavation is located on private lands.

Beach erosion is a pressing problem along much of the gulf coast of Northwest Florida. Hurricanes, of course, have the most devastating effect upon the shoreline. Since 1711, more than 70 hurricanes have crossed the Northwest Florida coast or passed close enough to cause damage. The Panama City area is central to the region and has been substantially affected by 12 hurricanes since 1856 (U.S. Army Corps of Engineers 1980). In addition to hurricanes, strong winter storms frequently produce serious erosion. On the average, 15 to 20 such storms occur each winter.

According to a study by the U.S. Army Corps of Engineers there are 44.6 mi of gulf shoreline along Bay County, 21.5 mi are subject to critical erosion, 17.3 mi to noncritical erosion, and only 5.8 mi are noneroding. Of the 27.9 mi in private ownership, 16.6 mi are for private recreational use. It is here that there is strong pressure for dealing with shoreline erosion. Critical erosion is defined in the study as "...those areas where erosion presents a serious problem because the rate of erosion considered in conjunction with economic, industrial, recreation, agricultural, navigational, demographic, ecological, or other relevant factors, (indicates) that action to halt such erosion may be (imperative)."

Following adoption of a 1970 resolution by the U.S. Senate Committee on Public Works, the Corps of Engineers prepared a report on the need for beach

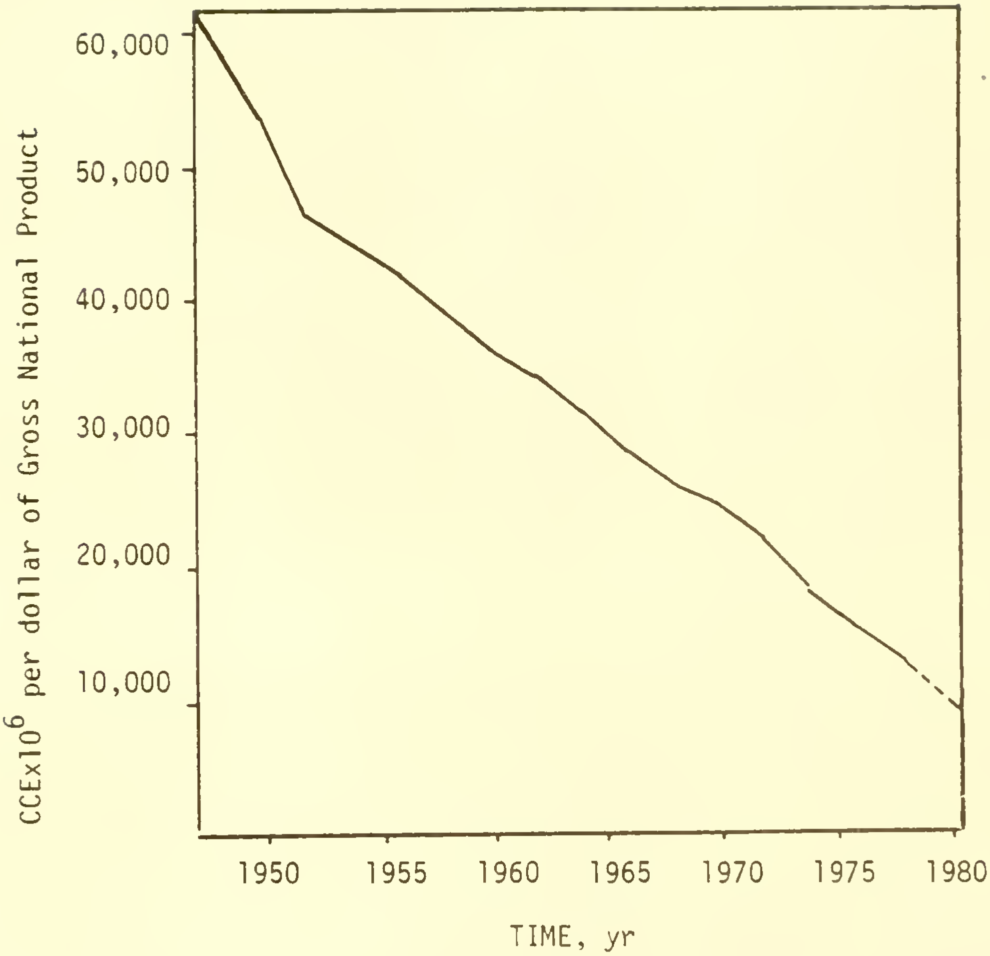


Figure 4. Coal equivalent calories per dollar of gross national product per year.

collected, because the cost of energy has been increasing steadily in recent years.

ENERGETICS MODELING METHODS

Step procedures for developing energetics models of socioeconomic and environmental systems are described in this section.

STEP 1: ECOLOGICAL SYSTEMS MAPPING

The important first step in the design of an energetics model is the identification of all principal natural and man-made systems. Each vegetative

cover type must be located and identified with sufficient precision to permit its area to be measured or reasonably estimated. Although areas of human activity also should be recorded, the energy human systems consume will be measured by using social and economic data as well as the area they occupy.

Land-use maps are a particularly good source of information but some exhibit serious deficiencies. Although land-use maps provide minute detail on human activities, the ecological systems that are not human-intensive are frequently aggregated into categories which are not suitable for the development of energetics models. For example, tidal marsh, mangroves, and other wetland vegetation types are frequently shown as some catch-all category such as "wet" land, or, worse, "idle" or "vacant" land.

This step produces a map of energy producers and users and the relative areas occupied by each. From this information, the energy flows of the natural systems can be calculated for the region. Unlike natural systems, the energy flows for areas of intensive human activity do not have their energy flows calculated from their total area, but instead use other measures of economic activity. Methods for calculating the respective energy flows are discussed in Step 3.

STEP 2: SYSTEMS BOUNDARIES

A systems boundary must be established by the researcher at the intial stages of the development of an energetics model. The boundary of the system is usually dictated by the purpose of the model. It is very helpful when the flow of energy across a boundary is minimized because energy flow across any boundary, as well as those within the system, must be carefully itemized. In many situations, the information necessary for the energetics model can be more easily collected and evaluated if significant natural systems are not divided. For example, a study for the National Park Service of the Redwood National Park (Alexander et al. 1980a) used county lines as system boundaries after the redwood habitat was mapped and found to be generally located within two adjacent counties. In other energetics modeling situations, counties or other political boundaries that may form an appropriate boundary seldom occur. Most frequently, the decision to use political boundaries, such as county lines, increases the difficulty of measuring natural systems. In the example given in this paper, a model of the City of Tampa would have many more significant flows across the city limits than would be necessary for a model of Hillsborough County, Florida, simply because a large portion of Tampa's labor force lives in the urban area surrounding the city but are largely contained in Hillsborough County.

STEP 3: IDENTIFICATION OF ENERGY FLOWS ACROSS THE SYSTEM BOUNDARY

Once the system boundary is defined, flows of energy into and out of the system can be identified. Normally these flows include solar energy in the form of sun, rain, and wind; fossil fuel energy in the form of electricity, petroleum, goods and services, and information; combinations of solar and fossil fuel energy in the form of people; and money.

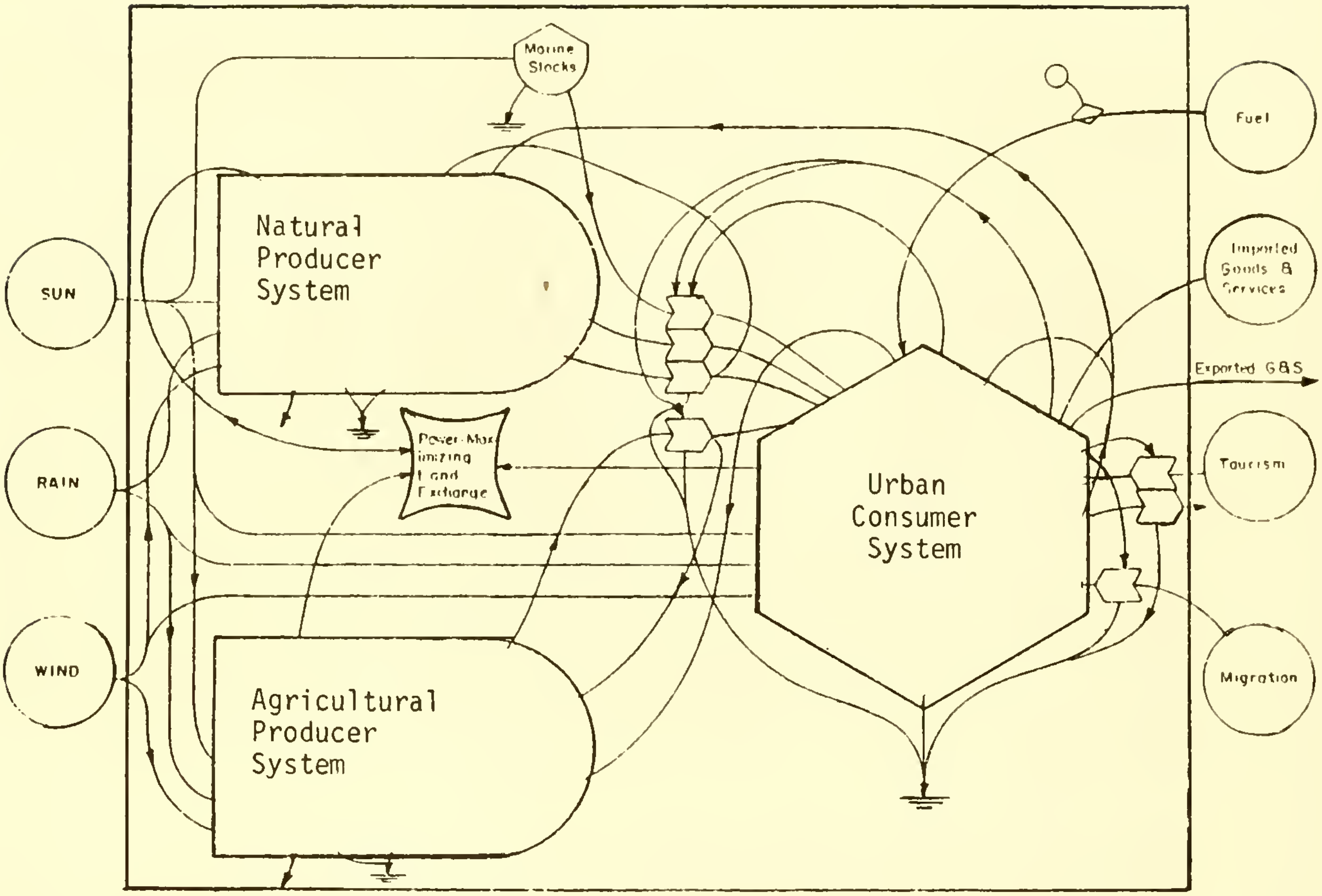


Figure 5. Basic Hillsborough County model.

This step in the modeling process is fulfilled by drawing a large rectangle around the system. The flows of energy across the boundary are represented as energy sources (circles, Step 2). The more dilute energy sources such as the sun, wind, and rain are customarily located in the lower left of the rectangle, whereas the more concentrated sources such as fossil fuel, petroleum, and information are shown on the top or right side of the rectangle. The energy quality increases from left to right.

STEP 4: IDENTIFICATION OF THE PRINCIPAL SUBSYSTEMS WITHIN THE SYSTEM

In the example of Hillsborough County, both natural and agricultural subsystems are shown (Figure 5). If agriculture were relatively unimportant, it might logically be included with the energy flows of the natural subsystem component. Examples of natural systems are estuaries, ponds, tropical forests, or grass prairies. The distinction between natural and agricultural systems is that natural systems are self-organizing and self-maintaining whereas agricultural systems require maintenance and organization. The important balance is to include all necessary detail in the energetics simulation without including detail of unnecessary subsystems. The identification of the subsystems to be modeled is dependent on the goals of the research

project, because the questions to be answered by the simulation determine the detail reflected in the systems components (Figure 5).

STEP 5: IDENTIFICATION OF INTERACTIONS BETWEEN SUBSYSTEMS AND SOURCES

In the Hillsborough County example (Figure 5), interactions between the subsystems and sources are shown by energy flow pathways. A matrix may be helpful to systematically identify these flows. The energy sources with internal sources such as the output of the urban system followed by the external sources in order of increasing energy concentration are listed on the vertical axis. The internal energy sinks followed by the external sinks are listed on the horizontal axis. An agricultural production unit is an example of an internal sink. Once the input/output matrix is completed an "X" may be used to indicate a significant energy flow pathway. The completed matrix now forms a guide to the necessary energy flow pathways to diagram the system, i.e., one energy flow pathway on the model will be represented by one "X" in the input/output matrix. If each energy flow in the input/output matrix was evaluated and the corresponding energy flow quantity used to replace the "X" in the matrix, an energy input/output model would result. For researchers familiar with economic input/output models, this may be a familiar arrangement with which to work.

STEP 6: ENERGY FLOWS WITHIN THE SUBSYSTEMS

A researcher can incorporate more detail into the model by further examining energy flows within individual system components. For example, Figure 6 shows the system detail for the production systems. Farms, salt marshes, and forests are typical production systems. The "producer" system shown by the bullet-shaped symbol contains a storage tank, which is an energy accumulator, or "counting" device and a feedback loop.

Once all subsystem diagrams showing energy flows and storages are completed, the energetics model is complete. The actual flows in the model must now be measured or calculated. To facilitate this, each flow pathway and storage symbol is assigned a unique identifier. These identifiers for a natural subsystem model, such as a forest, are shown in Figure 6.

STEP 7: EVALUATION OF THE ENERGETICS MODEL

Each storage and flow of energy identified in the previously drawn energetics diagram must now be quantified, or evaluated, as the quantification process is also called. The evaluation of the model can be done at a broad level, but it is much simpler to undertake this step at the subsystem level because the interdisciplinary nature of systems tends to make model evaluation difficult. Evaluation of energy flows and storages in the natural system can be based on information found in ecological literature (Lieth and Whittaker 1975), just as information on agricultural systems can be found in the agricultural literature. All flows of energy must adhere to the laws of thermodynamics. That is, energy may not be created or destroyed in any process, and

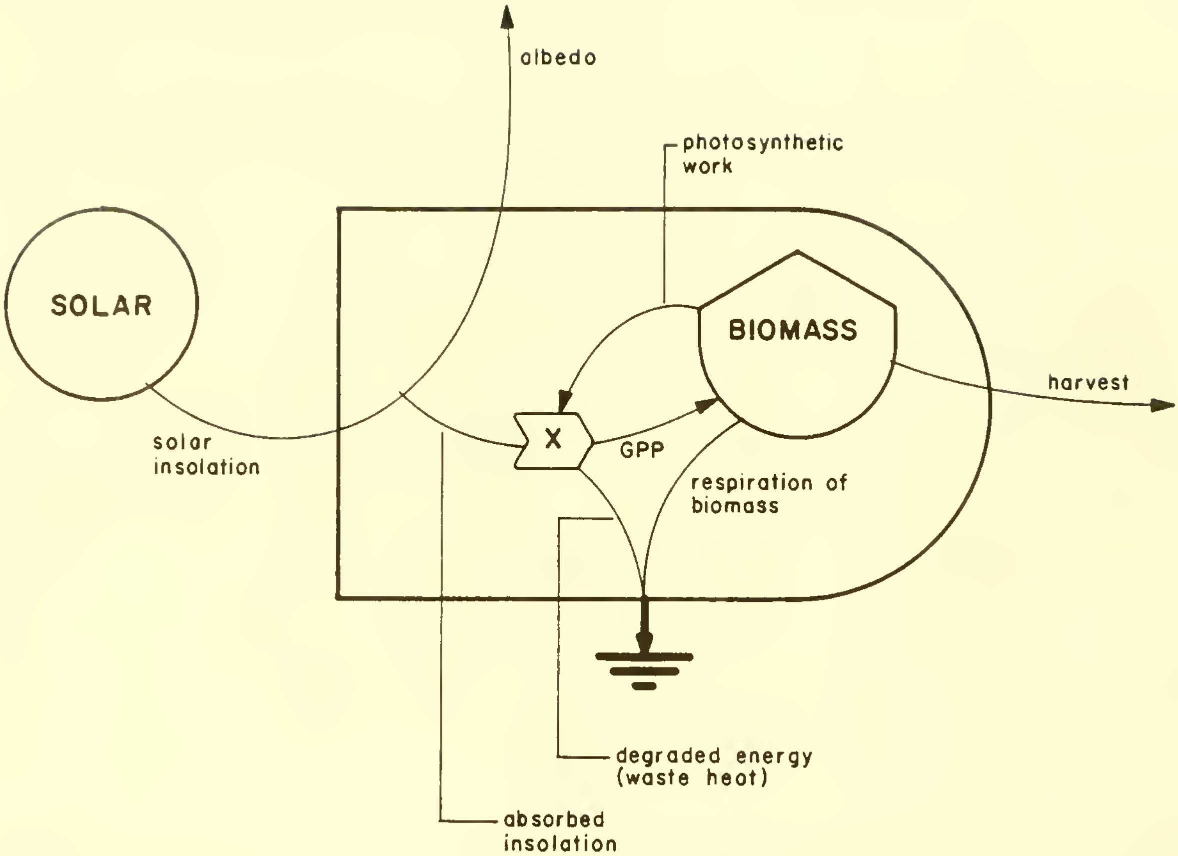


Figure 6. Simplified subsystem model of Hillsborough County natural production system.

some energy must be degraded in any real process. The first law states that the sum of the flows into and out of any interaction must be equal, whereas the second law or principle requires all interactions must have heat sinks for losses of unusable degraded energy. A separate evaluation should be set up for each of the subsystems being studied. It is necessary to include in this table all storages and flows of energy identified on the systems diagram prepared earlier. It is also necessary to document the calculations and relevant references for each of the flows and storages.

Figure 7 is an example of the results of evaluating the natural production system shown in Figure 6. The area of each natural ecosystem in the county was obtained from a 1978 map of Hillsborough County, Florida (Hillsborough County Environmental Protection Commision 1979). The solar insolation of a natural system was calculated by multiplying the solar insolation for Hillsborough County (1.5×10^6 cal/m^2/yr) by the land area of the natural system (1.23×10^8 m^2) yielding a total solar insolation of 1.84×10^{14} cal/yr. Eighty-six percent of the solar energy (1.6×10^{14} cal/yr) is absorbed leaving an albedo (reflection) of 14% (2.6×10^{13} cal/yr).

Next the energy stored in the biomass of Hillsborough County's natural system is calculated (see Table 2). The land area of each ecosystem is multi-

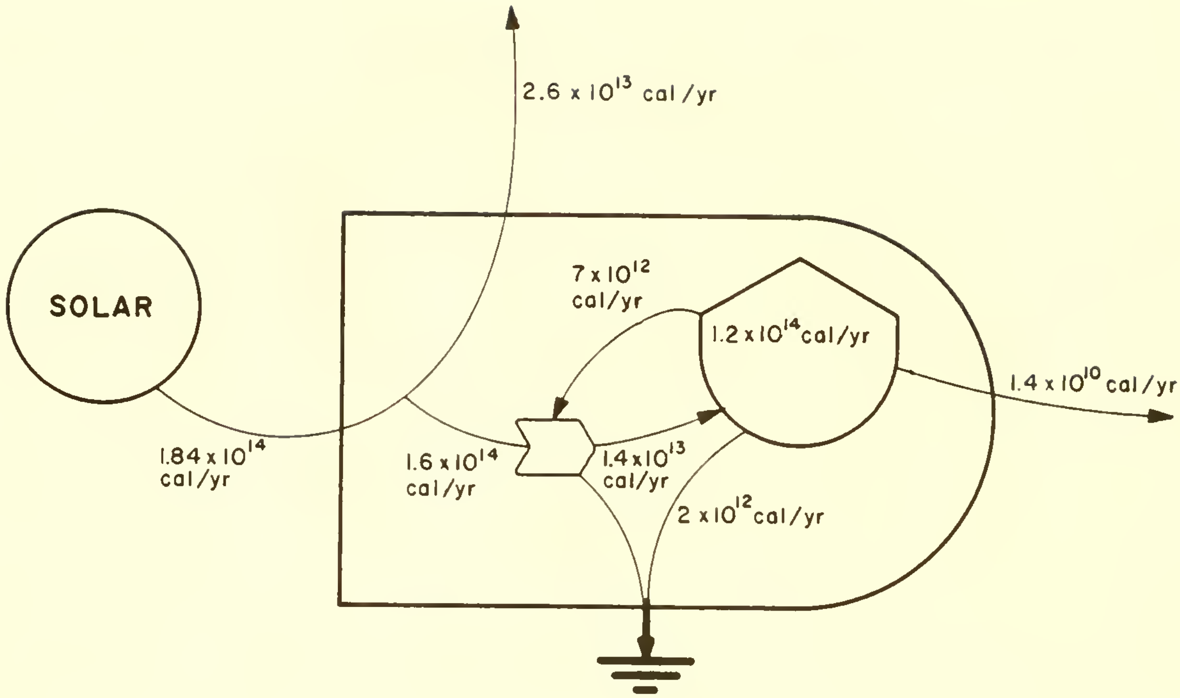


Figure 7. An evaluated model of the Hillsborough County natural system (see Figure 6 for energy flow pathway names).

plied by the mean weight of the particular ecosystem biomass. The energy stored in the biomass is computed by multiplying the cal/g of biomass dry weight by 4.25. The total energy stored in the biomass is computed by summing the individual ecosystem energy storage values. Similarly, the gross primary production of the boundaries area is computed and then summed. This is also illustrated by Table 2. Our experience has shown that splitting gross primary production equally between the work required for respiration and photosynthesis is a good first estimate.

The energy value of the harvest from the natural system was computed by multiplying the dollar value of the stumpage (total volume of wood harvested, i.e., 8.7 x 10^5) from Hillsborough County's natural system by the 1978 energy to dollar ratio from Figure 4 (1.6 x 10^4 cal/$) yielding 1.4 x$10^{10}$ cal/yr. The harvest is small when compared to the total energy stored in the natural system.

STEP 8: TRANSLATION OF ENERGETICS DIAGRAMS TO DIFFERENTIAL EQUATIONS

An energetics diagram is actually a differential equation in a pictorial form. Figure 8 is an example of an energy circuit model with its corresponding differential equation. The storage symbol in the diagram represents the equation state variable. The rate of change of the storage of energy is calculated by summing of all of the flows of energy into and out of the storage. Energy flows leaving the storage are given a minus sign. The differential equation for the natural system of Hillsborough County is given in Figure 8.

Table 2. Primary productivity estimates for Hillsborough County natural systems

Systems	Land area[a]	Biomass[b]		Gross primary productivity[b]	
	m^2	Kg/m^2	Cal	$Cal/m^2/yr$	Cal/yr
Pineland	1.8×10^8	35	4.2×10^{13}	1×10^4	2.8×10^{12}
Hammock	3.9×10^8	35	5.8×10^{13}	1.3×10^4	5.1×10^{12}
Cypress	1.1×10^8	35	1.6×10^{13}	1.3×10^4	1.4×10^{12}
Marsh and Slough	5.6×10^7	15	3.6×10^{12}	2.4×10^4	1.3×10^{12}
Mangroves	2.8×10^8	1	1.2×10^{12}	1.2×10^4	3.4×10^{12}
Lakes and Ponds	5.6×10^7	0.02	4.8×10^9	3.2×10^3	1.8×10^{11}
Scrub	5.6×10^7	1.6	3.8×10^{11}	4.8×10^3	2.7×10^{11}
	12.3×10^8		1.2×10^{14}		1.4×10^{13}

[a]Hillsborough County Environmental Protection Commission 1979.
[b]Lieth and Whittaker 1975.

Similarly, the research would continue through the entire energetics diagram, translating each storage into its appropriate mathematical analog. Each term in the differential equation represents a specific energy flow in the model. The initial value of the energy flows and storages are used to calculate the pathway coefficients in the equation. For example, the flow of energy on pathway k_4N is 7×10^{12} cal/yr (from Figure 7) thus:

$$7 \times 10^{12} = k_4N$$

$$\therefore k_4 = 5.83 \times 10^2$$

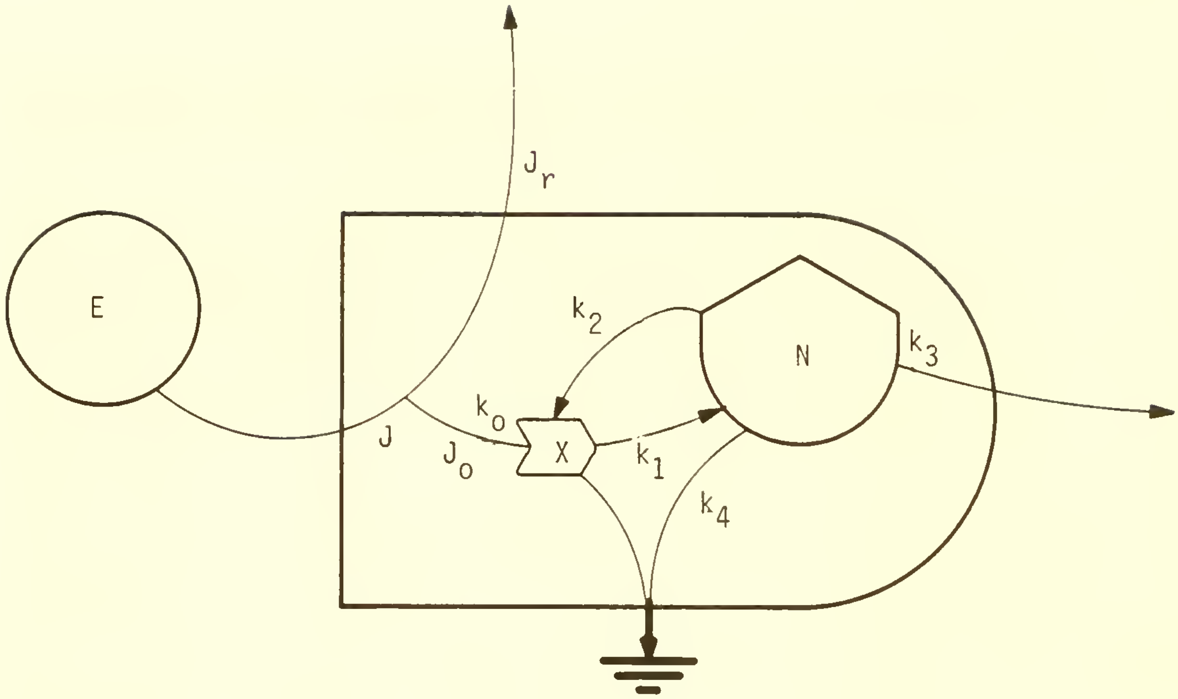


Figure 8. Energetics model of Hillsborough County natural system illustrating the translation of the model into differential equation form.

$N = (k_1 - k_2)J_rN - k_3N - k_4N$ = differential equation for N

where

E = Energy source (solar, rain, and wind)

N = natural biomass

k_n = energy flow coefficients

J = inflow of energy (solar insolation)

J_r = energy not used (albedo)

J_o = energy absorbed by system (absorbed insolation)

$J = J_r + J_o$ = conservation of energy

$J_o = k_oJ_rN$

$\therefore J = J_r + k_oNJ_r$

$$\dot{N} = \frac{(k_1 + k_2)}{1 + k_oN} \quad JN = k_3N - k_4N$$

STEP 9: SIMULATION OF THE ENERGETICS MODEL

With the revolution in computer technology, it became more feasible for the average researcher to simulate simultaneous solution of complex sets of nonlinear differential equations such as one encounters in energetics models. The two most popular simulation methods are: (1) the development of analogous electrical circuits through the use of computer, and (2) numerical approximation using a digital computer. Each of these two methods has advantages and disadvantages, but because digital computers are more frequently available to the researcher, numerical approximation is the method more commonly employed. A more detailed discussion of the simulation process is incorporated into the "Results" section in Step 10.

STEP 10: VALIDATION OF THE ENERGETICS MODEL

There is no specific test to establish the validity of any large-scale simulation model. Correlation analysis and other statistical methods have been used by some researchers to compare similarities between the behavior of the model and the behavior of the system itself as it functions in reality; however, the results of these methods of analysis are inconclusive.

Sensitivity analysis is helpful in validating large-scale simulation models. Individual pathway coefficients are varied to test the system's sensitivity of changes in the linkages. Sensitivity analysis is often helpful in finding errors in the model design or construction when unexpected behavior occurs.

Other attempts at validating energetics simulation results are: (1) to use historical data in the mode, simulating a period from the initial time to the present, allowing simulation results to be compared with currently available empirical data; (2) in cases where the system being simulated is relatively well understood, comparing the simulation results to known system behavior can assist in the validation of a given energetics model. For example, the researcher might be interested in changes in the simulation results as different variables are changed to reflect the impact of hypothetical future actions and events.

RESULTS OF ENERGETICS MODELS

INTRODUCTION TO HILLSBOROUGH COUNTY MODEL

In illustrating the methodology for preparing an energetics simulation, as was done previously in this report, a simple example was used. In this section, a more complex model is considered, one that has been used to illustrate energy alternatives to public administrators.

The earlier model (Figure 5), and the one prepared for this section (Figure 9), share the same structure incorporating "natural," "agricultural," and "human" subsystems. The results discussed in this section are of this expanded model.

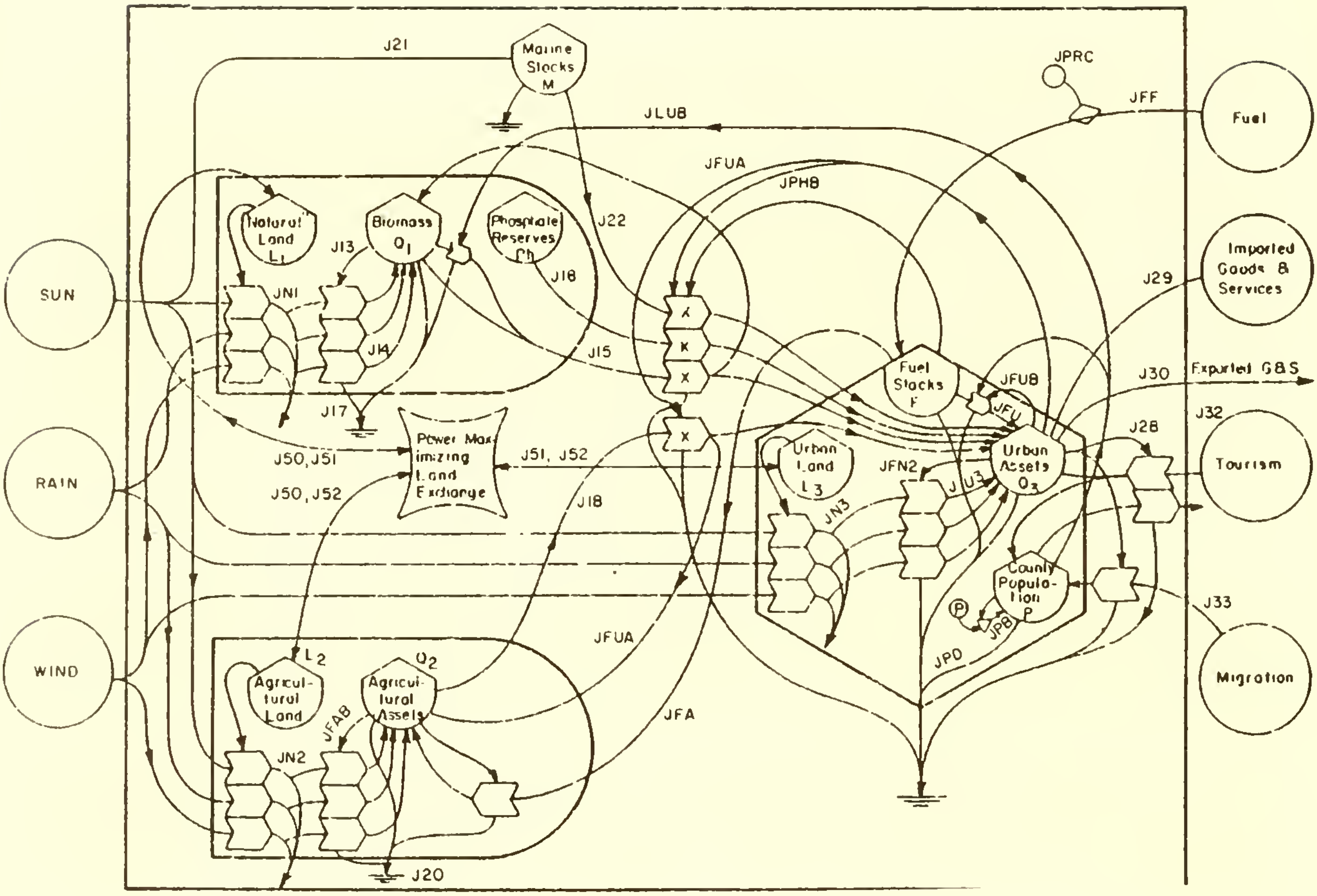


Figure 9. Detailed energy model of Hillsborough County (Sipe et al. 1979).

The energy circuit model of Hillsborough County, used as an example in this section, was developed as part of the Energy Basis of the Hillsborough County Project at the Center for Wetlands, University of Florida, sponsored by the Hillsborough County Environmental Protection Agency, John F. Alexander, Jr., and H. T. Odum, principal investigators. The simulation model was developed as part of the project by Dennis Swaney and report by Sipe, Swaney, and McGinty (1979).

Description of the Region

Hillsborough County, Florida, near the center of the west coast of Florida, is almost square in shape, about 36 miles along each side. The total area of 1,235 mi^2, is slightly larger than that of the State of Rhode Island.

The county is relatively flat, elevations range from sea level to a high of 49 m (165 ft) in the eastern part of the county. The four principal natural regions of the county are sandhill highlands, inland flatwoods, coastal lowlands, and river valleys. The county has a subtropical climate, mild winters (average January temperature, 15°C or 59°F) and warm humid summers (average August temperature, 20°C or 82°F).

Overview of the Hillsborough County Model

In research situations, each energetics model must be tailored to the particular application at hand; each energetics model incorporates its unique features into the design. Although it is beyond the scope of this report to examine in detail all facets of the Hillsborough County model, some of the more salient features are summarized in the following paragraphs.

One such feature is the "Power Maximizing Land Exchange," shown as the four-cornered logic module in the approximate center of the diagram. It redistributes land between the three subsystems. Hillsborough County, like many Florida coastal counties, has a rapidly increasing population. This increase has brought about a conversion of some of the natural and agricultural lands to urban lands, as the City of Tampa and its surrounding communities have grown. The model exchanges land between the three sectors according to the relative value of the change in gross county energy flow, just as in actual land changes between sectors as land becomes economically feasible to develop (or preserve) within a subsystem. Land exchange is important because the natural energy flows into each subsystem are proportional to the total land area.

In addition to monitoring changes in land areas, the Hillsborough County model also simulates changes in the marine environment and in phosphate reserves. Both are important to the local economy and were included in the model to show county administrators the effect of different scenarios on these resources.

Another feature of this particular model is the fuel price monitor in the upper right-hand corner of the diagram. (It is represented by the small circle and diamond.) As the price of fuel increases, the rate of fuel imported per unit of exported goods and services declines. This allows the effects of fuel increases to be simulated. "What if" scenarios, such as "What if the price of fuel doubles?" can be examined using this feature and can be compared with the results of alternative scenarios.

A summary of the synthesis of socioeconomic and natural system data (Tables 3 and 4) was made by evaluating the energy flows and storages in the Hillsborough County model (Figure 9).

Results of Energetics Simulations

The results of the Hillsborough County energetics simulation are shown in Figure 10. Using 1948 data, the model simulated historical changes in the land area of each subsystem and of population for the county. The values obtained by the simulation closely paralleled the actual data available for 1978. (Although the oil embargo of 1972 did affect energy flows in each subsystem of the county, the effects on land area and population were small in comparison to changes in 1948.) Although the rate of conversion slowed when the simulation was continued into the future, the historical trend of land in the natural subsystem being converted into urban and agricultural land continued (Figure 10). This simulation was predicated on the assumption that fossil fuel, such as oil, coal, and natural gas would continue to be available through the end of the century, but it included a sudden price jump in 1973 for these fuels to reflect world events as they occurred.

Table 3. Synthesis of 1975 socioeconomic and natural system energy storage data for Hillsborough County (Sipe et al. 1979).

Storage	Description and value
L1	Total land in natural systems of Hillsborough County = 7.781 x 10^8 m (Hillsborough County Environmental Protection Commission 1979)
Q1	Total biomass of natural systems of Hillsborough County = 1.94 x 10^{13} Kg = 8 x 10^{13} cal (Lieth and Whittaker 1975)
Ph	Total phosphate reserves currently estimated to exist in Hillsborough County = 2 x 10^8 short tons = 1.81 x 10^{11} Kg
L2	Total land in farms for Hillsborough County = 1.445 x 10^9 m^2 (Hillsborough County Environmental Protection Commission 1979)
Q2	Embodied energy value of farm assets = 1.008 x 10^{13} cal (Florida Department of Revenue 1976)
L3	Total land area of human systems (e.g., urban, industrial, residential) = 5.558 x 10^8 m^2 (Hillsborough County Environmental Protection Commission 1979)
Q3	Embodied energy of total assessed value of land and buildings of Hillsborough County 1974 (less agricultural assets) = 1.18 x 10^{14} cal (U.S. Department of Agriculture 1977)
P	Population of Hillsborough County in 1974 = 5.87 x 10^5 people (Bureau of Economic and Business Research 1975)
F	Energy value of Hillsborough County Fuel Stocks (1 year of storage = 3.87 x 10^{13} Cal)
M	Total primary productivity in local marine ecosystem = 4.1 x 10^{12} cal (Lieth and Whittaker 1975)

Simulation of Alternative Futures for Hillsborough County

Energetics simulations not only provide information on the future impact of current trends, but also permit alternative scenarios to be simulated. In the case of the Hillsborough County simulation, several alternative scenarios were investigated. One assumed that fossil fuel prices would be governed by an increasing "surcharge" starting in 1973, not just a single price increase. The results of this simulation, shown in Figure 11, show a decrease in urban assets to levels of the 1950's. (The data shown in Figure 11, with the exception of population, are in coal equivalent calories.) The decline in urban assets reflects a changing standard of living in Hillsborough County brought

Table 4. Synthesis of 1975 socioeconomic and natural system energy flow data for Hillsborough County (all energy flows in 10 caloric coal equivalent per year) (Sipe et al. 1979)

Flow	Description
JNI	Sum of climatic energies available to natural ecosystems (sun, rain, wind) = 312.9 (Swaney 1978)
JN2	Sum of climatic energies available to agro-ecosystems (sun, rain, wind) = 581.0 (Swaney 1978)
JN3	Sum of climatic energies available to urban systems (sun, rain, wind) = 224.4 (Swaney 1978)
JFF	Total fossil fuel input to county functions = 3,677.0 (U.S. Department of Agriculture 1977)
JPRC	Price function of fuel, which regulated fuel input to the county
JFA	Fossil fuel input to agriculture = JFF-JFU-JFD = 3,671.0 (Florida State Energy Office 1978a, 1978b; Tampa Electric Company 1976)
JFD	Annual depreciation of fuel stocks = 77
J13	Feedback from natural sector stocks to natural sector production = 2,360. 20% of gross primary production (Lieth and Whittaker 1975)
J14	Usuable climatic energy to natural sector = JN1
J15	Input from natural to urban sector = 1.6 (Bureau of Economic and Business Research 1977)
J16	Input from phosphate to urban sector = 326 (Bureau of Economic and Business Research 1977)
J17	Depreciation of natural sector (vertical heat loss) = 124.5 (Swaney 1978)
J18	Input from agriculture to urban sector = 250 (U.S. Department of Agriculture 1977)
J19	Usable climatic energy to agricultural sector = JN2
J20	Depreciation to agricultural section (vertical heat loss) = 231 (Swaney 1978)
J21	Sum of inputs to marine system = 90.4 (Heath and Wimberly 1971)

(Continued)

Table 4. Concluded.

Flow	Description
J22	Input from marine to urban system = 4.1 (Bureau of Economic and Business Research 1977)
J28	Embodied energy invested in tourism = 690 (Bureau of Economic and Business Research 1977)
J29	Embodied energy of imported goods and services = 1,416
J30	Embodied energy of exported goods and services = 1,363
J31	Depreciation of urban sector (vertical heat loss) = 89
J32	Embodied energy subsidy from tourism = 690 (Bureau of Economic and Business Research 1977)
J33	Population growth due to county assets (i.e., migration) = 20,500 people/yr (Bureau of Economic and Business Research 1977)
JPB	Intrinsic county birth rate = 8,100 people/yr (Bureau of Economic and Business Research 1977)
JPD	Intrinsic county death rate = 4,000 people/yr (Bureau of Economic and Business Research 1977)
JFN2	Feedback from urban stocks to urban production = 45
JU3	Usable climatic energy to urban sector = JN3 (Swaney 1978)
JUAB	Feedback from agricultural stocks to agricultural production = 116 (U.S. Department of Agriculture 1977)
JFUB	Feedback from urban sector to fuel system = 387
JPHB	Feedback from urban sector to phosphate production = 65.2
JLUB	Feedback from urban sector to natural sector = 0.16
JFUA	Feedback from urban sector to agricultural sector = 199 (U.S. Department of Agriculture 1977)
J50	Land exchange between natural and agricultural sectors
J51	Land exchange between natural and urban sectors
J52	Land exchange between agricultural and urban sectors

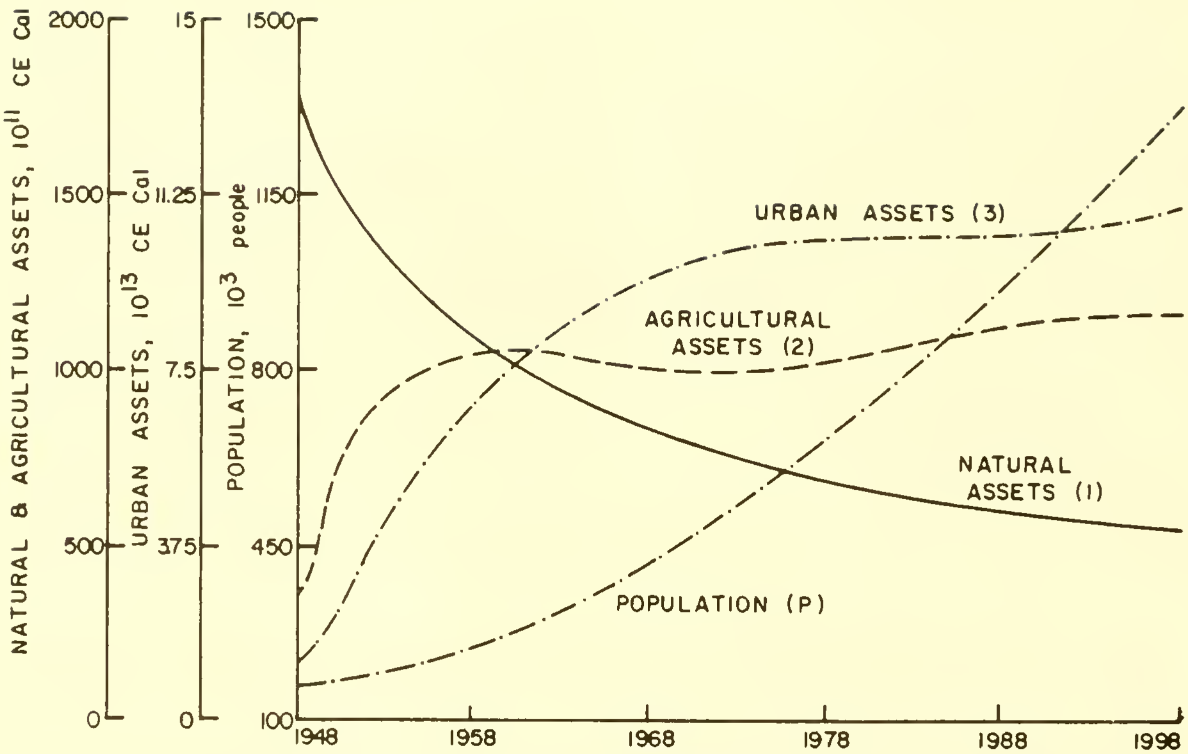


Figure 10. Simulation result of Hillsborough County model with constantly increasing relative imported fuel price and a price jump in 1973 (Sipe et al. 1979).

on by the increased price of fuel, which in turn increased the price of virtually all other goods and services. It not only included the reduced purchasing power of Hillsborough County's exports, but also included, for example, the increased cost of law enforcement and other social services as the county "makes do" with less.

A final simulation considered the impact of a drop in fossil fuel prices due to a hypothetical technological innovation simulated to occur in 1983 (Figure 12). The principal result of this scenario is an increase in the standard of living for residents of Hillsborough County.

Although this particular scenario was assumed to result from a decreased fossil fuel price, the same results would be expected to occur if, for example, there were improvements in fuel efficiency and other energy conservation methods. In the actual study from which these simulations of Hillsborough County were taken, recommendations were made as to which energy conservation techniques, from an energy flow standpoint, showed the greatest promise and how those techniques might best be implemented. These recommendations addressed such subjects as land use, construction techniques, transportation, and others.

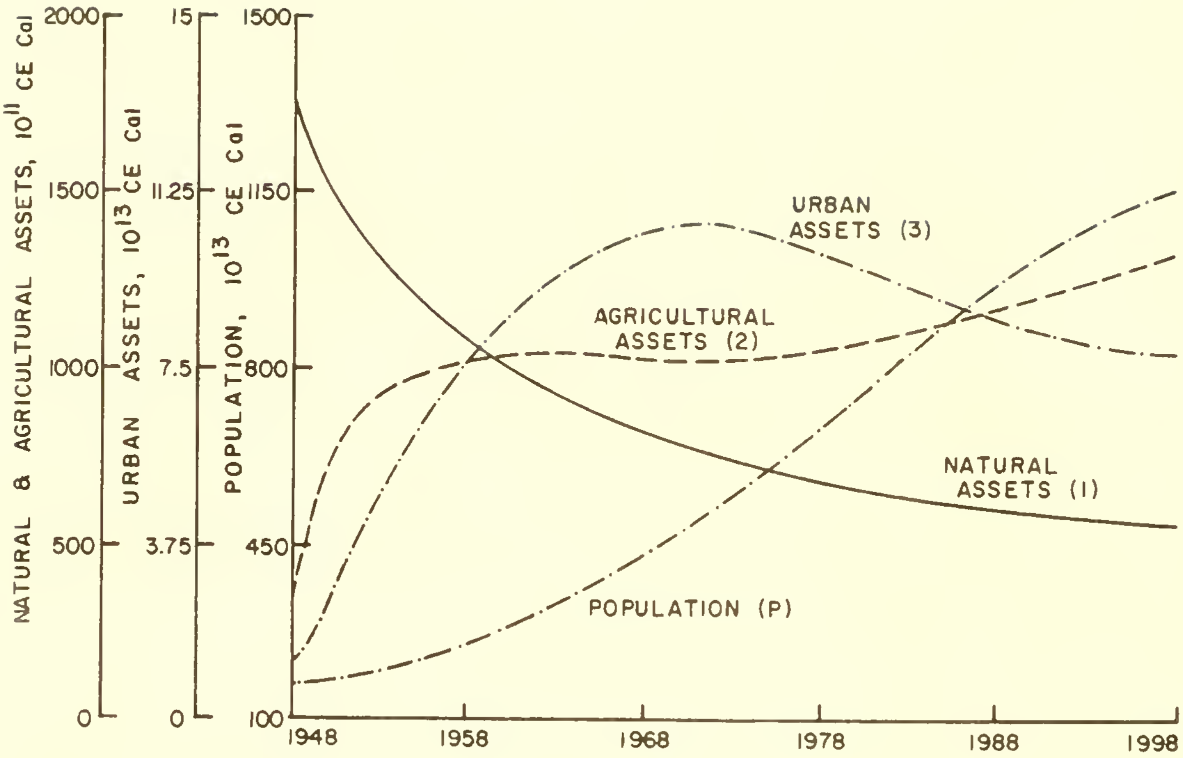


Figure 11. Simulation result of Hillsborough County model with constantly increasing relative fuel prices and a price jump in 1973 with an increasing fuel surcharge beginning in 1973. (Sipe et al. 1979).

USES OF ENERGETICS MODELS

SIMULATIONS

One of the principal uses of energetics models is the simulation of a system from some historical time through the present and into the future. The simulation results of the historical period permit the results of the simulation to the present to be compared with available empirical data. Assuming the simulation performs well in these "benchmark" tests, it is then continued into the future. These simulated results -- telling the researcher of likely trends, given the present and historical data -- are the most common application of energetics models. It is important to know that the simulation results can only be as good as the modeler's ability to comprehend the system under study. Construction of models that reflect actual conditions is difficult.

Frequently, the simulation is prepared to permit the relative advantages and disadvantages of alternative courses of action to be compared. For example, energetics models have been used to examine alternative methods for cooling a proposed nuclear power plant (Odum 1978). This study compared cooling towers, a man-made reservoir, and a nearby lake as possible methods by which the waste heat generated as a by-product of the power generation process could best be returned to the natural environment.

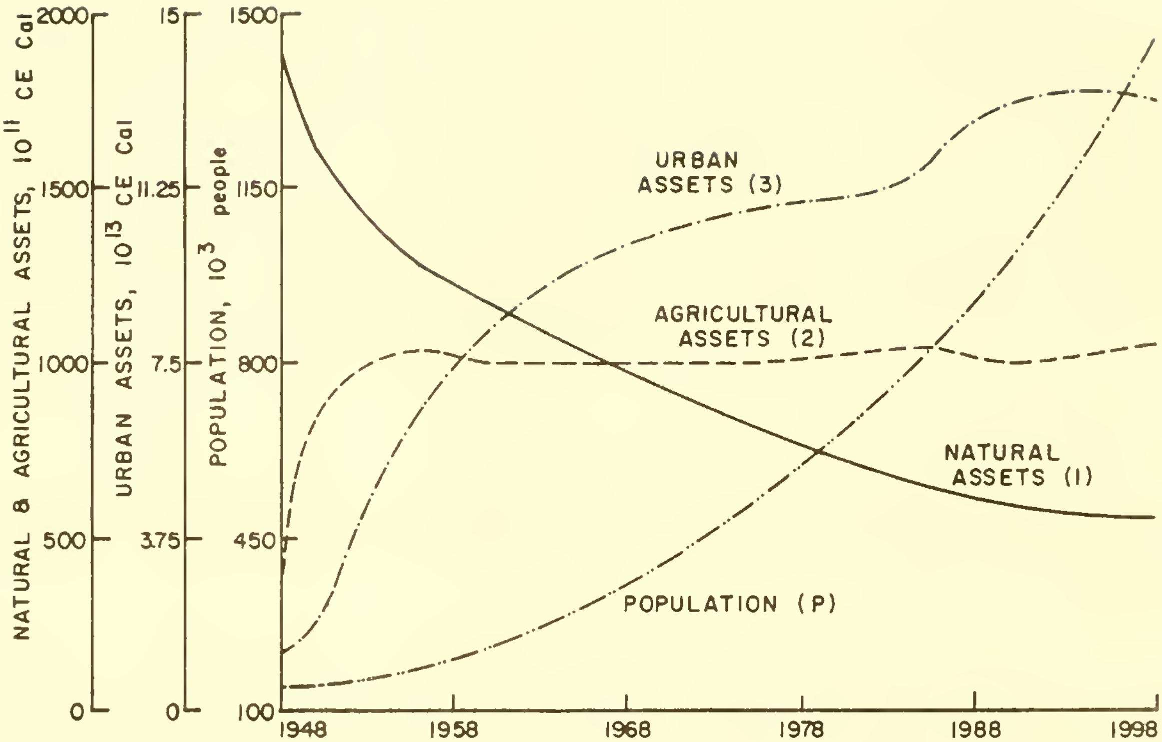


Figure 12. Simulation result of Hillsborough County model with technical innovation such as energy conservation implemented in 1983. (Sipe et al. 1979).

In the Hillsborough County example, comparisons were made between different hypothetical future events that were generally outside the control of the system under study such as changes in world oil prices. Depending upon the likelihood of these hypothetical events, the researcher (or the decision-maker) may identify other courses of action that minimize any adverse consequences of the outside events. For example, one alternative scenario investigated in the Hillsborough County study assumed that a future technological breakthrough might cause energy prices to fall. Such a technological advance would have numerous beneficial effects on society according to the simulation. The Hillsborough County study also commented that the same simulation results would be expected to occur if, for example, greater efficiency could be attained in the use of presently available energy resources. In this case, Hillsborough County governmental decisionmakers do have methods by which energy conservation measures might be encouraged. And, to the degree these methods improve the efficiency of the system's use of energy, the benefits -- basically, an improved standard of living and quality of life -- suggested by the simulation should be expected to accrue in the system.

Whether or not energetics modeling is a useful research tool, even its proponents admit that the development and simulation of a detailed energetics model is an involved, complex process. There are alternatives to the complete modeling process, however, and, under certain circumstances, these methods are appropriate for comparing specific alternatives.

Basically, the investigation of energy ratios (Figure 13) involves the same methodology but with only a carefully selected portion of one component (or series of components) of an energetics mode. For example, in Figure 14, yield ratios were calculated for electric power plants, by comparing a coal-fired power plant with that of an oil-fired power plant (Alexander et al. 1980b). The output of each hypothetical power plant was held constant at 17.83×10 coal equivalent calories per year (CE Cal/yr). The cost to society to mine and transport the fuel, to build and maintain the physical plant, and the operational costs of the plant are shown as the feedback from the main economy. Comparing these feedbacks to the output of each power plant, respectively, shows the yield ratio. The yield ratio of 12.2 for oil and 5.5 for coal illustrates the economy of oil over coal.

LIMITATIONS OF ENERGETICS MODELS

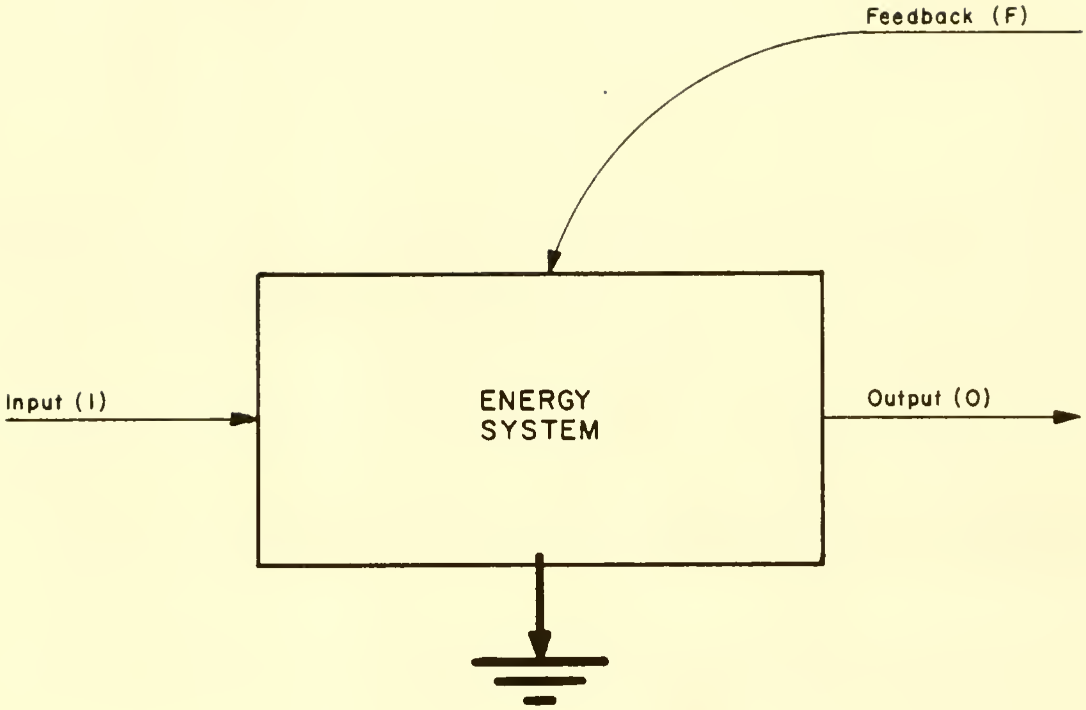
Two limitations that frequently affect the use of energetics models are the frequent lack of appropriate data with which to calibrate the simulation, and the difficulty associated with validation of the results of a particular energetics model.

Collecting the data necessary to estimate the magnitude of each energy flow in the system being studied can be an involved and time-consuming process. Data are seldom usable as found. Mapped data may not include sufficient detail concerning ecological systems, as was mentioned in the methods section. Data from some governmental agencies are often not always compatible with other government agencies. In some cases, traditional methods used by a particular discipline did not permit easy standardization with data expressed in some other unit of measurement. In cases such as these, baseline research must establish appropriate conversion methodologies. This is being done by more and more users.

Closely related to the data-availability problems are the problems associated with validation of the simulation results. If leaders in government and business are to commit their resources to the solutions suggested by energetics models, those leaders must know the degree to which the model is a valid predictor of future systems behavior. Unfortunately, the validation of the results of a particular energetics model applied to a particular problem is difficult.

In addition, theoretical research is producing verifiable data that can in turn be used by any number of future users. The illustration of energy ratios given in Figure 14 is one such example. In it, the researchers established the relative energy quality of wood, numerous coal types, fossil fuels, and other energy sources.

The trend toward a more complex and unified body of knowledge continues. As the body of knowledge surrounding energetics models increases, it will eventually provide a sufficient base allowing for more complex but efficient model simulation.



Net Energy = O - F

Yield Ratio = $\frac{O}{F}$

Investment Ratio = $\frac{F}{I}$

Efficiency Ratio = $\frac{O}{I}$

Figure 13. Energy ratios (Odum and Odum 1976).

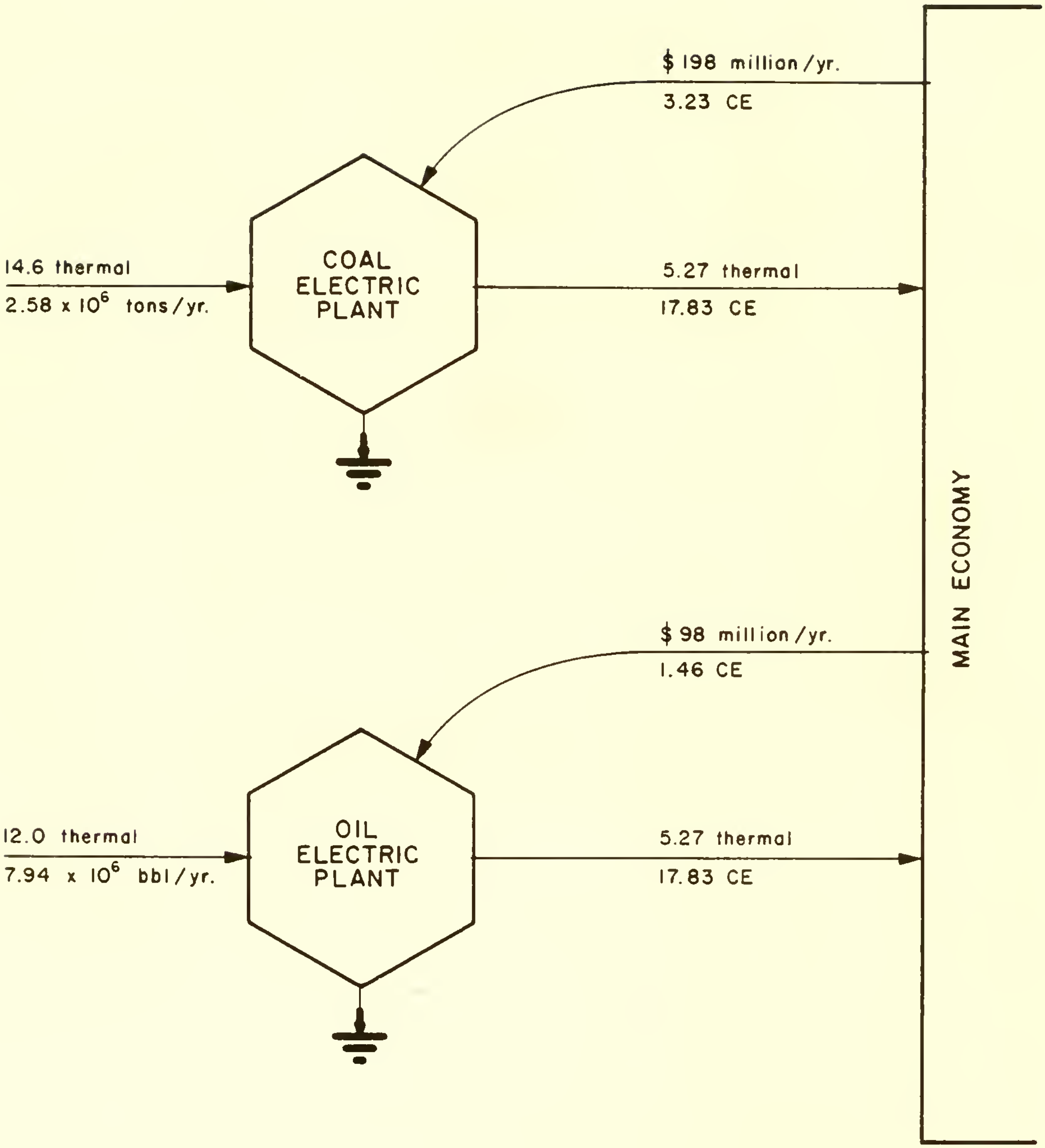


Figure 14. Yield ratios of coal-fired and oil-fired electric power plants (Values are 10^{12} Cal/year unless noted otherwise) (Alexander et al. 1980b).

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16. Abstract (Limit 200 words)

Data are compiled from existing sources on the social and economic characteristics of the Northwestern coastal region of Florida, which is made up of Escambia, Santa Rosa, Okaloosa, Walton, Bay, Gulf, and Franklin Counties. Described are the components and interrelationships among complex processes that include population and demographics characteristics, mineral production, multiple-use conflicts, recreation and tourism, agricultural production, sport and commercial fishing, transportation, industrial and residential development, and environmental issues and regulations. Energetics models of socioeconomic systems are also presented.

The report consists of one volume of text and two volumes that contain the data appendix.

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Socioeconomic status, demography, land development, fisheries, transportation, models, agriculture, mineral resources, recreation

b. Identifiers/Open Ended Terms

Northwestern Florida

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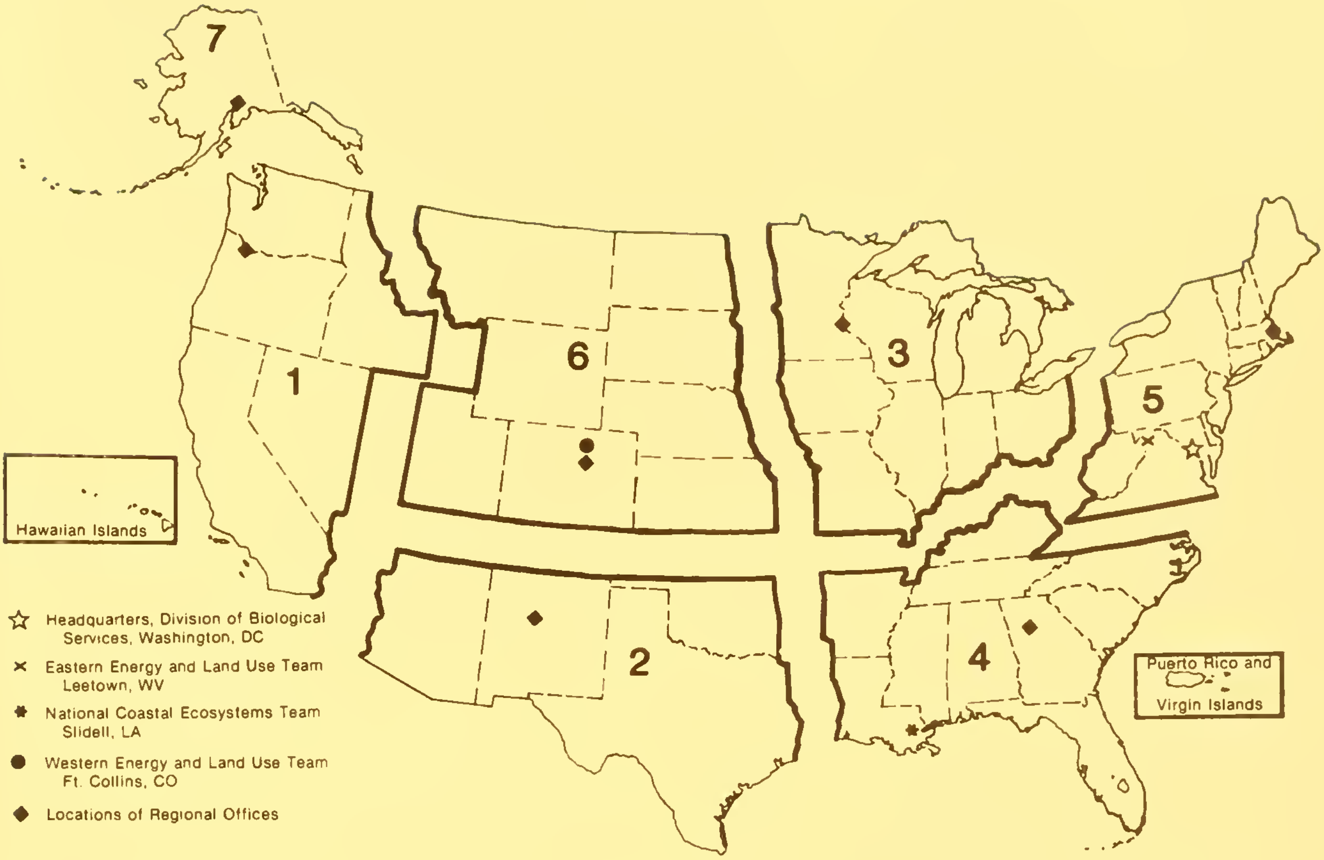

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